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TABLE BOOK

FOR

CIVIL & MECHANICAL ENGINEERS.

COMPILED BY

GEO. W PLYMPTON,
M. AM. SOC. C. E.

NEW YORK:
D. VAN NOSTRAND COMPANY,
23 MURRAY AND 27 WARREN STS.,
1892.

CONTENTS.

METRICAL SYSTEM.

(Compared with English.)

LONG MEASURE.

	Metres.	Inches.	Feet.	Yards.	Miles.
Millimetre.....	.001	.03937	.00328	.00109	—
Centimetre.....	.01	.3937	.0328	.0109	—
Decimetre.....	.1	3.937	.328	.1093	—
METRE*....	1	39.37079	3.2809	1.09363	—
Decametre	10	—	32.809	10.936	—
Hectometre.....	100	—	328	109.36	—
Kilometre.....	1,000	—	3280.9	1093.6	.62138

SQUARE MEASURE.

	Square Metres.	Square Inches.	Square Feet.	Square Yards.	Acres.
Milliare.....	.1	155	1.076	.119	—
Centiare†.....	1	1550	10.764	1.19	.00025
Deciare.....	10	15501	107.64	11.96	.0025
ARE.....	100	—	1076.4	119.6	.0247
Decare.	1,000	—	—	1,196	.2471
Hectare.....	10,000	—	—	11,960	2.4711

* 1 metre = 1.093633056 yard.
† Or 1 square metre = 1.196033292 square yard.

Solid Measure.

	Cubic Metre.	Cubic Inches.	Cubic Feet.	Cubic Yards.
Millistere.....	.001	61.028	—	—
Centistere.....	.01	610.28	.353	—
Decistere.....	.1	6,102.8	3.5317	.1308
Stere, or cubic metre.	1	61,028	35.317	1.308
Decastere.....	10	—	—	13.08

Weights.

	Gr'ms.	Avoir-dupois ounces.	Avoir-dupois lbs.	Cwts.	Tons.	Grains Troy.
Milligramme...	.001	—	—	—	—	.015
Centigramme..	.01	—	—	—	—	.154
Decigramme..	.1	—	—	—	—	1.543
Gramme.....	1	.035	.0022	—	—	15.432349
Decagramme..	10	.35	.022	—	—	
Hectogramme..	100	3.527	.22046	—	—	Oz. Troy.
Kilogramme...	1,000	35.2739	2.2046	.019	.00098	32.15

Fluid Measure.

	Litres.	Inches.	Feet.	Gallons.
Millilitre.....	.001	.061	—	.00026
Centilitre.....	.01	.61	—	.0026
Decilitre.....	.1	6.1	—	.026
Litre.....	1	61.02	.0353	.26
Decalitre.....	10	610.28	.353	2.64
Hectolitre.....	100	—	3.53	26.4

Linear Measures.

		Metres.
Inch	=	.0253
Foot	=	.3047
Yard	=	.9143
Rod	=	5.0291
Chain	=	20.1164
Mile	=	1609.3149

Square Measures.

		Square metres.
Square inch	=	.000645
" foot	=	.092899
" yard	=	.836097
Rod	=	25.29194
Acre	=	4046.71

Cubic Measures.

		Cubic metres.
Cubic inch	=	.000016386
" foot	=	.0283153
" yard	=	.764513

Measures of Capacity.

Liquid Measure.

		Litres.
Pint	=	.473
Quart	=	.946
Gallon (U. S.)	=	3.784
Gallon (Imperial)	=	4.544

DRY MEASURE.

		Litres.
Quart	=	1.101
Peck..... ..	=	8.808
Bushel (U. S.).....	=	35.24
Bushel (Imperial) ...	=	36.349

WEIGHTS.

		Grammes.
Ounce (avoirdupois).	=	28.349
Pound " .	=	453.592
Grain (Troy).....	=	.0648
Pennyweight (Troy).	=	1.555175
Ounce " .	=	31.10346
Pound " .	=	373.2419

METRES REDUCED TO FEET.

M.	Feet.	M.	Feet.	M.	Feet.
1	3.281	34	111.551	67	219.820
2	6.561	35	114.831	68	223.101
3	9.843	36	118.112	69	226.382
4	13.124	37	121.393	70	229.663
5	16.404	38	124.674	71	232.944
6	19.685	39	127.955	72	236 225
7	22.966	40	131.236	73	239.506
8	26.247	41	134.517	74	242.787
9	29.528	42	137.798	75	246.067
10	32 809	43	141.079	76	249.348
11	36.090	44	144.360	77	252.629
12	39.371	45	147.640	78	255.910
13	42.652	46	150.921	79	259.191
14	45 933	47	154.202	80	262.472
15	49.213	48	157.483	81	265.753
16	52.494	49	160.764	82	269.034
17	55.775	50	164 045	83	272.315
18	59.056	51	167.326	84	275.596
19	62.337	52	170.607	85	278.876
20	65 618	53	173.888	86	282.157
21	68.899	54	177.169	87	285.438
22	72.180	55	180.449	88	288.719
23	75.461	56	183.730	89	292.000
24	78.742	57	187.011	90	295 281
25	82.022	58	190.292	91	298.562
26	85.303	59	193.573	92	301.843
27	88.584	60	196 854	93	305.124
28	91.865	61	200.135	94	308.405
29	95 146	62	203.416	95	311.685
30	98.427	63	206.697	96	314.966
31	101 708	64	209.978	97	318.247
32	104.989	65	213.258	98	321.528
33	108 270	66	216.539	99	324.809

FEET REDUCED TO METRES.

F.	Metres.	F.	Metres.	F.	Metres.
1	.305	34	10.363	67	20.421
2	.609	35	10.668	68	20.726
3	.914	36	10.973	69	21.031
4	1.219	37	11.277	70	21.336
5	1.524	38	11.582	71	21.640
6	1.829	39	11.888	72	21.945
7	2.133	40	12.192	73	22.250
8	2 438	41	12.497	74	22.555
9	2.743	42	12.801	75	22.860
10	3.048	43	13.106	76	23.164
11	3.353	44	13.411	77	23.469
12	3.657	45	13.716	78	23.774
13	3.962	46	14 020	79	24.079
14	4.267	47	14.325	80	24.384
15	4.572	48	14.630	81	24.688
16	4.877	49	14.935	82	24.993
17	5.181	50	15.240	83	25.298
18	5.486	51	15.544	84	25 603
19	5.791	52	15.849	85	25.907
20	6.096	53	16.154	86	26.212
21	6.401	54	16.459	87	26.517
22	6.705	55	16.764	88	26.822
23	7.010	56	17.068	89	27 127
24	7.315	57	17.373	90	27.431
25	7.620	58	17.678	91	27.736
26	7.925	59	17.983	92	28 041
27	8.229	60	18 288	93	28.346
28	8.534	61	18.592	94	28.651
29	8.839	62	18.897	95	28.955
30	9.144	63	19 202	96	29.260
31	9.449	64	19.507	97	29 565
32	9.753	65	19 812	98	29 870
33	10.058	66	20.116	99	30.175

METRES REDUCED TO INCHES.

M.	Inches.	M.	Inches.	M.	Inches.
1	39.371	34	1338.61	67	2637.84
2	78.742	35	1377.98	68	2677.21
3	118.112	36	1417.35	69	2716.58
4	157.483	37	1456.72	70	2755.954
5	196.854	38	1496.09	71	2795.33
6	236.225	39	1535.46	72	2834.70
7	275.596	40	1574.832	73	2874.07
8	314.966	41	1614.20	74	2913.44
9	354.337	42	1653.57	75	2952.81
10	393.708	43	1692.94	76	2992 18
11	433.079	44	1732 31	77	3031.55
12	472 449	45	1771.69	78	3070.92
13	511.820	46	1811.06	79	3110.29
14	551.191	47	1850.43	80	3149 662
15	590.562	48	1889.80	81	3189.03
16	629.933	49	1929.17	82	3228.40
17	669.303	50	1968 540	83	3267 77
18	708 674	51	2007.91	84	3307.15
19	748.045	52	2047.28	85	3346.52
20	787.416	53	2086.65	86	3385.89
21	826.787	54	2126.02	87	3425.26
22	866.157	55	2165.39	88	3464.63
23	905.528	56	2204.76	89	3504.00
24	944 899	57	2244 14	90	3543.370
25	984.270	58	2283 51	91	3582.74
26	1023.64	59	2322 88	92	3622.11
27	1063.01	60	2362.247	93	3661.48
28	1102.38	61	2401 62	94	3700.85
29	1141.75	62	2440.99	95	3740.22
30	1181.124	63	2480.36	96	3779.59
31	1220.49	64	2519.73	97	3818.97
32	1259 87	65	2559.10	98	3858.34
33	1299 24	66	2598.47	99	3897 71

INCHES REDUCED TO METRES.

In.	Metres.	In.	Metres.	In.	Metres.
1	.025400	34	.86358	67	1.70177
2	.050799	35	.88898	68	1.72717
3	.076199	36	.91438	69	1.75257
4	.101598	37	.93978	70	1.77796
5	.126998	38	.96518	71	1.80337
6	.152397	39	.99058	72	1.82877
7	.177797	40	1.01598	73	1.85417
8	.203196	41	1.04138	74	1.87957
9	.228596	42	1.06678	75	1.90497
10	.253995	43	1.09218	76	1.93037
11	.279395	44	1.11758	77	1.95576
12	.304794	45	1.14298	78	1.98116
13	.330194	46	1.16838	79	2.00656
14	.355594	47	1.19378	80	2.03196
15	.380993	48	1.21918	81	2.05736
16	.406393	49	1.24458	82	2.08276
17	.431792	50	1.26997	83	2.10816
18	.457192	51	1.29538	84	2.13356
19	.482591	52	1.32078	85	2.15896
20	.507990	53	1.34618	86	2.18436
21	.533390	54	1.37158	87	2.20976
22	.558790	55	1.39697	88	2.23516
23	.584189	56	1.42237	89	2.26056
24	.609589	57	1.44777	90	2.28595
25	.634989	58	1.47317	91	2.31136
26	.660388	59	1.49857	92	2.33676
27	.685788	60	1.52397	93	2.36216
28	.711187	61	1.54937	94	2.38756
29	.736587	62	1.57477	95	2.41296
30	.761986	63	1.60017	96	2.43836
31	.787386	64	1.62557	97	2.46376
32	.812785	65	1.65097	98	2.48915
33	.838185	66	1.67637	99	2.51455

INCHES AND 16THS INTO MILLIMETRES.

In.	Mill.	In.	Mill.	In.	Mill.
1/16	1.587	2 1/8	53.974	4 3/16	106 36
1/8	3.174	2 3/16	55.561	4 1/4	107.95
3/16	4.762	2 1/4	57.149	4 5/16	109.54
1/4	6.350	2 5/16	58.736	4 3/8	111 12
5/16	7.937	2 3/8	60.324	4 7/16	112.71
3/8	9.524	2 7/16	61.911	4 1/2	114.30
7/16	11.112	2 1/2	63.499	4 9/16	115.89
1/2	12.700	2 9/16	65.086	4 5/8	117.47
9/16	14.287	2 5/8	66.674	4 11/16	119.06
5/8	15.875	2 11/16	68.261	4 3/4	120 65
11/16	17.462	2 3/4	69.849	4 13/16	122.24
3/4	19.050	2 13/16	71.436	4 7/8	123.82
13/16	20.637	2 7/8	73.024	4 15/16	125.41
7/8	22 225	2 15/16	74.611	5	127.00
15/16	23.812	3	76.199	5 1/16	128.59
1	25.400	3 1/16	77.786	5 1/8	130.17
1 1/16	26.987	3 1/8	79.374	5 3/16	131.76
1 1/8	28.574	3 3/16	80.961	5 1/4	133.35
1 3/16	30.162	3 1/4	82.549	5 5/16	134.94
1 1/4	31.749	3 5/16	84.136	5 3/8	136.52
1 5/16	33.337	3 3/8	85.723	5 7/16	138 11
1 3/8	34.924	3 7/16	87.311	5 1/2	139.70
1 7/16	36 512	3 1/2	88.898	5 9/16	141 28
1 1/2	38.099	3 9/16	90.486	5 5/8	142.87
1 9/16	39.687	3 5/8	92 073	5 11/16	144.46
1 5/8	41.274	3 11/16	93 661	5 3/4	146.05
1 11/16	42.862	3 3/4	95.248	5 13/16	147.63
1 3/4	44.449	3 13/16	96.836	5 7/8	149 22
1 13/16	46.037	3 7/8	98.423	5 15/16	150.81
1 7/8	47.624	3 15/16	100.01	6	152.40
1 15/16	49.212	4	101.60	6 1/16	153.98
2	50.799	4 1/16	103.19	6 1/8	155.57
2 1/16	52.387	4 1/8	104.77	6 3/16	157.16

MILES TO KILOMETRES.

Miles.	Kilos.	Miles.	Kilos.	Miles,	Kilos.
1	1.609	34	54.717	67	107.824
2	3.219	35	56.326	68	109.433
3	4.828	36	57.935	69	111.043
4	6.437	37	59.545	70	112.652
5	8.047	38	61.154	71	114.261
6	9 656	39	62.763	72	115.871
7	11.265	40	64.373	73	117.480
8	12.874	41	65.982	74	119.089
9	14 484	42	67.591	75	120.699
10	16.093	43	69.200	76	122 308
11	17.702	44	70.810	77	123.917
12	19.312	45	72.419	78	125.527
13	20.921	46	74.028	79	127.136
14	22.530	47	75.638	80	128 745
15	24.140	48	77.247	81	130 355
16	25.749	49	78.856	82	131.964
17	27 358	50	80.466	83	133.573
18	28.968	51	82 075	84	135.182
19	30.577	52	83.684	85	136.792
20	32.186	53	85.294	86	138.401
21	33.796	54	86.903	87	140.010
22	35.405	55	88.512	88	141.620
23	37.014	56	90.122	89	143.229
24	38.624	57	91.731	90	144.838
25	40.233	58	93.340	91	146.448
26	41.842	59	94.950	92	148.057
27	43.451	60	96 559	93	149.666
28	45.061	61	98.168	94	151.276
29	46.670	62	99.777	95	152 885
30	48 279	63	101.387	96	154.494
31	49.889	64	102.996	97	156 104
32	51.498	65	104.605	98	157 713
33	53.107	66	106.215	99	159 322

KILOMETRES TO MILES.

Kilos.	Miles.	Kilos.	Miles.	Kilos.	Miles.
1	.621	34	21.127	67	41.633
2	1.243	35	21.748	68	42.254
3	1.864	36	22.370	69	42.875
4	2 485	37	22.991	70	43.497
5	3.107	38	23.612	71	44.118
6	3.728	39	24.234	72	44.739
7	4 350	40	24.855	73	45.361
8	4.971	41	25.477	74	45 982
9	5.592	42	26.098	75	46 604
10	6.214	43	26.719	76	47.225
11	6.835	44	27.341	77	47.846
12	7.457	45	27.962	78	48.468
13	8.078	46	28.584	79	49.089
14	8.699	47	29.205	80	49.711
15	9.321	48	29.826	81	50.332
16	9.942	49	30.448	82	50.953
17	10.563	50	31.069	83	51.575
18	11.185	51	31.690	84	52.196
19	11.806	52	32.312	85	52.817
20	12.428	53	32.933	86	53.439
21	13.049	54	33.555	87	54.060
22	13.670	55	34.176	88	54.681
23	14.292	56	34.797	89	55.303
24	14.913	57	35.419	90	55.924
25	15.535	58	36 040	91	56.546
26	16 156	59	36.662	92	57.167
27	16.777	60	37 283	93	57.789
28	17.399	61	37.904	94	58.410
29	18.020	62	38.526	95	59.031
30	18.641	63	39 147	96	59.653
31	19.263	64	39.768	97	60.274
32	19.884	65	40.390	98	60.895
33	20.506	66	41.011	99	61.517

SQUARE CENTIMETRES TO SQUARE INCHES.

Cen.	Inches.	Cen.	Inches.	Cen.	Inches.
1	.155	34	5 270	67	10.385
2	.310	35	5.425	68	10.540
3	.465	36	5 580	69	10.695
4	.620	37	5.735	70	10.850
5	.775	38	5.890	71	11.005
6	.930	39	6.045	72	11.160
7	1.085	40	6.200	73	11.315
8	1.240	41	6.355	74	11.470
9	1.395	42	6.510	75	11.625
10	1.550	43	6 665	76	11.780
11	1.705	44	6.820	77	11 935
12	1.860	45	6.075	78	12.090
13	2.015	46	7.130	79	12.245
14	2.170	47	7.285	80	12.400
15	2.325	48	7.440	81	12.555
16	2.480	49	7.595	82	12.710
17	2.635	50	7.750	83	12 865
18	2.790	51	7.905	84	13.020
19	2.945	52	8.060	85	13.175
20	3.100	53	8.215	86	13.330
21	3.255	54	8.370	87	13.485
22	3.410	55	8.525	88	13.640
23	3.565	56	8.680	89	13.795
24	3.720	57	8.835	90	13 950
25	3.875	58	8.990	91	14 105
26	4.030	59	9.145	92	14 260
27	4.185	60	9.300	93	14.416
28	4.340	61	9.455	94	14 571
29	4.495	62	9.610	95	14.726
30	4.650	63	9.765	96	14.881
31	4.805	64	9.920	97	15 036
32	4 960	65	10 075	98	15.191
33	5 115	66	10 230	99	15.346

SQUARE INCHES TO SQUARE CENTIMETRES.

In.	Cen.	In.	Cen.	In.	Cen.
1	6.451	34	219.346	67	433.242
2	12.903	35	225.798	68	438 693
3	19.354	36	232.249	69	445.144
4	25 805	37	238.701	70	451.596
5	32.257	38	245.152	71	458 047
6	38.708	39	251.603	72	464.498
7	45 160	40	258 055	73	470.950
8	51.611	41	264.506	74	477.401
9	58.062	42	270 957	75	483.852
10	64.514	43	277.409	76	490.304
11	70 965	44	283.860	77	496.755
12	77.416	45	290 311	78	503.207
13	83.868	46	296.763	79	509.658
14	90.319	47	303 214	80	516.109
15	96.770	48	309.666	81	522.561
16	103.222	49	316.117	82	529 012
17	109.673	50	322 568	83	535.463
18	116.125	51	329.020	84	541.915
19	122.576	52	335.471	85	548.366
20	129.027	53	341.992	86	554.818
21	135.479	54	348.374	87	561 269
22	141.930	55	354.825	88	567 720
23	148.381	56	361.277	89	574.172
24	154.833	57	367.728	90	580.623
25	161.284	58	374.179	91	587.074
26	167.736	59	380.631	92	593.526
27	174.187	60	387.082	93	599.977
28	180.638	61	393.533	94	606.428
29	187.090	62	399.985	95	612.880
30	193.541	63	406.436	96	619.331
31	199.992	64	412.887	97	625 783
32	206.444	65	419.339	98	632.234
33	212.895	66	425.790	99	638.685

SQUARE METRES TO SQUARE FEET.

M.	Feet.	M.	Feet.	M.	Feet.
1	10.764	34	365.986	67	721.208
2	21.529	35	376.751	68	731.972
3	32.293	36	387.515	69	742.737
4	43.057	37	398.279	70	753.501
5	53.821	38	409.043	71	764.265
6	64.586	39	419.808	72	775.030
7	75.350	40	430.572	73	785.794
8	86.114	41	441.336	74	796.558
9	96.879	42	452.101	75	807.323
10	107.643	43	462.865	76	818 087
11	118.407	44	473.629	77	828.851
12	129.172	45	484.394	78	839.615
13	139.936	46	495.158	79	850.380
14	150.700	47	505.922	80	861 144
15	161.465	48	516.686	81	871.908
16	172.229	49	527.451	82	882.673
17	182.993	50	538.215	83	893.437
18	193.757	51	548.979	84	904.201
19	204.522	52	559.744	85	914.966
20	215.286	53	570.508	86	925.730
21	226.050	54	581.272	87	936.494
22	236.815	55	592.037	88	947.258
23	247.579	56	602.801	89	958.023
24	258.343	57	613.565	90	968.787
25	269.108	58	624.329	91	979.551
26	279.872	59	635.094	92	990.316
27	290.636	60	645 858	93	1001.08
28	301.400	61	656.622	94	1011.84
29	312.165	62	667.387	95	1022.61
30	322 929	63	678.151	96	1033.37
31	333.693	64	688.915	97	1044 14
32	344.458	65	699.680	98	1054.90
33	355.222	66	710.444	99	1065 67

SQUARE FEET TO SQUARE METRES.

F.	Metres.	F.	Metres.	F.	Metres.
1	.093	34	3.159	67	6.224
2	.186	35	3 251	68	6.317
3	.279	36	3.344	69	6.410
4	.372	37	3.437	70	6.503
5	.464	38	3.530	71	6.596
6	.557	39	3 623	72	6.689
7	.650	40	3.716	73	6.782
8	.743	41	3.809	74	6.875
9	.836	42	3.902	75	6.967
10	.930	43	3.995	76	7.060
11	1.022	44	4.088	77	7.153
12	1.115	45	4.180	78	7.246
13	1.208	46	4.273	79	7.339
14	1.300	47	4.366	80	7.432
15	1.393	48	4.459	81	7.525
16	1.486	49	4.552	82	7.618
17	1.579	50	4.645	83	7.711
18	1.672	51	4.738	84	7.804
19	1.765	52	4.831	85	7.896
20	1.858	53	4.924	86	7.989
21	1.951	54	5.017	87	8.082
22	2.044	55	5.109	88	8.175
23	2.137	56	5.202	89	8.268
24	2.230	57	5.295	90	8.361
25	2.322	58	5 388	91	8.454
26	2 415	59	5.481	92	8.547
27	2.508	60	5 574	93	8.640
28	2.601	61	5.667	94	8.733
29	2.694	62	5.760	95	8.825
30	2.787	63	5.853	96	8.918
31	2.880	64	5.946	97	9.011
32	2 973	65	6 038	98	9.104
33	3.066	66	6.131	99	9.197

SQUARE METRES TO SQUARE YARDS.

M.	Yards.	M.	Yards.	M.	Yards.
1	1.196	34	40.665	67	80.134
2	2.392	35	41.861	68	81.330
3	3.588	36	43 057	69	82.526
4	4.784	37	44.253	70	83.722
5	5.980	38	45.449	71	84.918
6	7.176	39	46.645	72	86.114
7	8.372	40	47.841	73	87.310
8	9.568	41	49.037	74	88.506
9	10.764	42	50.233	75	89.702
10	11.960	43	51 429	76	90.898
11	13.156	44	52.625	77	92.095
12	14.352	45	53.821	78	93.291
13	15.548	46	55.017	79	94.487
14	16 744	47	56.214	80	95.683
15	17.940	48	57.410	81	96.879
16	19.136	49	58.606	82	98.075
17	20.333	50	59.802	83	99.271
18	21.529	51	60.998	84	100.467
19	22.725	52	62.194	85	101.663
20	23.921	53	63.390	86	102.859
21	25.117	54	64.586	87	104.055
22	26.313	55	65.782	88	105.251
23	27.509	56	66.978	89	106.447
24	28 705	57	68.174	90	107 643
25	29.901	58	69.370	91	108.839
26	31.097	59	70.566	92	110.035
27	32.293	60	71.762	93	111.231
28	33.489	61	72 958	94	112.427
29	34 685	62	74.154	95	113 623
30	35.881	63	75 350	96	114.819
31	37.077	64	76 546	97	116 015
32	38.273	65	77 742	98	117.211
33	39.469	66	78.938	99	118.407

SQUARE YARDS TO SQUARE METRES.

Y.	Metres.	Y.	Metres.	Y.	Metres.
1	.836	34	28.427	67	56.018
2	1.672	35	29.263	68	56.855
3	2.508	36	30.099	69	57.691
4	3 344	37	30.936	70	58.527
5	4.180	38	31.772	71	59 363
6	5.017	39	32.608	72	60.199
7	5 853	40	33.444	73	61.035
8	6.689	41	34.280	74	61.871
9	7.524	42	35.116	75	62.707
10	8 361	43	35.952	76	63.543
11	9.197	44	36.788	77	64.379
12	10.033	45	37.624	78	65.216
13	10.869	46	38.460	79	66.052
14	11.705	47	39 297	80	66.888
15	12.541	48	40.133	81	67.724
16	13.378	49	40.969	82	68.560
17	14.213	50	41.805	83	69.396
18	15.050	51	42.641	84	70.232
19	15.886	52	43.477	85	71.068
20	16.722	53	44.313	86	71.904
21	17.558	54	45.149	87	72 740
22	18.394	55	45.985	88	73 576
23	19.230	56	46.821	89	74 413
24	20.066	57	47.657	90	75.249
25	20.902	58	48.494	91	76.085
26	21.738	59	49.330	92	76 921
27	22.574	60	50.166	93	77.757
28	23.411	61	51.002	94	78.593
29	24.247	62	51.838	95	79.429
30	25.083	63	52.674	96	80.265
31	25.919	64	53.510	97	81.101
32	26.755	65	54 346	98	81.937
33	27.591	66	55.182	99	82.774

CUBIC CENTIMETRES TO CUBIC INCHES.

Cen.	Inches.	Cen.	Inches.	Cen.	Inches.
1	.061	34	2.075	67	4.089
2	.122	35	2.136	68	4.150
3	.183	36	2.197	69	4.211
4	.244	37	2.258	70	4.272
5	.305	38	2.319	71	4.333
6	.366	39	2.380	72	4.394
7	.427	40	2.441	73	4 455
8	.488	41	2.502	74	4.516
9	.549	42	2.563	75	4.577
10	.610	43	2.624	76	4.638
11	.671	44	2.685	77	4.699
12	.732	45	2.746	78	4.760
13	.793	46	2.807	79	4.821
14	.854	47	2.868	80	4.882
15	.915	48	2.929	81	4.943
16	.976	49	2.990	82	5.004
17	1.037	50	3.051	83	5.065
18	1.098	51	3.112	84	5.126
19	1.159	52	3.173	85	5.187
20	1.221	53	3.234	86	5 248
21	1.282	54	3.295	87	5.309
22	1.343	55	3.356	88	5.370
23	1.404	56	3.417	89	5.431
24	1.465	57	3.479	90	5.492
25	1.526	58	3.540	91	5.553
26	1.587	59	3.600	92	5.614
27	1.648	60	3.662	93	5 675
28	1.709	61	3.723	94	5.736
29	1.770	62	3.784	95	5.797
30	1.831	63	3.845	96	5.859
31	1.892	64	3.906	97	5.920
32	1.953	65	3.967	98	5.981
33	2.014	66	4.028	99	6.042

CUBIC INCHES TO CUBIC CENTIMETRES.

In.	Cen.	In.	Cen.	In.	Cen.
1	16.386	34	557.130	67	1097.87
2	32.772	35	573.516	68	1114 26
3	49.158	36	589 902	69	1130.65
4	65.545	37	606.288	70	1147.032
5	81.931	38	622.675	71	1163.42
6	98.317	39	639.061	72	1179.80
7	114 703	40	655.447	73	1196.19
8	131.089	41	671 833	74	1212.58
9	147.476	42	688 219	75	1228.96
10	163.862	43	704.606	76	1245.35
11	180.248	44	720.992	77	1261.74
12	196.634	45	737.378	78	1278.12
13	213.020	46	753.764	79	1294.51
14	229.406	47	770.150	80	1310.894
15	245.793	48	786.536	81	1327.28
16	262.179	49	802.923	82	1343.67
17	278.565	50	819 309	83	1360.05
18	294.951	51	835.695	84	1376.44
19	311.337	52	852.081	85	1392.82
20	327.723	53	868.467	86	1409.21
21	344.110	54	884.853	87	1425.60
22	360.496	55	901.240	88	1441.98
23	376 882	56	917.626	89	1458.37
24	393.268	57	934.012	90	1474.756
25	409.654	58	950.398	91	1491.14
26	426.041	59	966.784	92	1507.53
27	442.427	60	983.170	93	1523.91
28	458.813	61	999.557	94	1540.30
29	475.199	62	1015.94	95	1556.69
30	491.585	63	1032.33	96	1573,07
31	507.971	64	1048.72	97	1589.46
32	524 358	65	1065.10	98	1605.85
33	540.744	66	1081.49	99	1622 23

CUBIC METRES TO CUBIC YARDS.

M.	Yards.	M.	Yards.	M.	Yards.
1	1.308	34	44.473	67	87.637
2	2.616	35	45.781	68	88.945
3	3.924	36	47.089	69	90.253
4	5.232	37	48.397	70	91.561
5	6.540	38	49.705	71	92.869
6	7.848	39	51 013	72	94.178
7	9.156	40	52.321	73	95.486
8	10.464	41	53.629	74	96.794
9	11.772	42	54.937	75	98.102
10	13.080	43	56.245	76	99.410
11	14.388	44	57.553	77	100.719
12	15.696	45	58.861	78	102.026
13	17.004	46	60.169	79	103.334
14	18.312	47	61.477	80	104.641
15	19.620	48	62.785	81	105.950
16	20.928	49	64.093	82	107.258
17	22.236	50	65.401	83	108.566
18	23.544	51	66.709	84	109.874
19	24.852	52	68 017	85	111.182
20	26.160	53	69.325	86	112.490
21	27.468	54	70.633	87	113.798
22	28.776	55	71.941	88	115.106
23	30.084	56	73.249	89	116.414
24	31.392	57	74.557	90	117.721
25	32 700	58	75.865	91	119.030
26	34.009	59	77.173	92	120.338
27	35.317	60	78.481	93	121.646
28	36.625	61	79.789	94	122.954
29	37.933	62	81.097	95	124.262
30	39.240	63	82.405	96	125.570
31	40.549	64	83.713	97	126.878
32	41.857	65	85.021	98	128 186
33	43.165	66	86 329	99	129 494

CUBIC YARDS TO CUBIC METRES.

Y.	Metres.	Y.	Metres.	Y.	Metres.
1	.764	34	25.993	67	51.222
2	1.529	35	26.758	68	51.987
3	2.293	36	27.522	69	52.751
4	3.058	37	28.287	70	53.516
5	3.823	38	29.051	71	54.280
6	4.587	39	29.816	72	55.045
7	5.352	40	30 580	73	55.809
8	6.116	41	31.345	74	56.574
9	6.881	42	32.110	75	57.338
10	7.645	43	32 874	76	58.103
11	8.410	44	33.639	77	58.867
12	9.174	45	34.403	78	59.632
13	9.939	46	35.168	79	60.397
14	10.703	47	35.932	80	61 161
15	11.468	48	36.697	81	61.926
16	12.232	49	37.461	82	62.690
17	12.997	50	38.226	83	63.455
18	13.761	51	38.990	84	64.219
19	14.526	52	39.755	85	64.984
20	15.290	53	40.519	86	65.748
21	16.054	54	41.284	87	66.513
22	16.819	55	42.048	88	67.277
23	17 584	56	42 813	89	68.042
24	18.348	57	43.577	90	68.806
25	19 113	58	44.342	91	69.571
26	19.877	59	45.106	92	70.335
27	20.642	60	45.871	93	71.100
28	21.406	61	46.635	94	71.864
29	22.171	62	47.400	95	72.629
30	22.935	63	48.164	96	73.393
31	23 700	64	48.929	97	74.158
32	24.464	65	49.693	98	74.922
33	25.229	66	50.458	99	75.687

GRAMMES TO GRAINS.

G.	Grains.	G.	Grains.	G.	Grains.
1	15.432	34	524.700	67	1033.97
2	30.864	35	540.132	68	1049.40
3	46.297	36	555.564	69	1064.83
4	61.729	37	570.997	70	1080.264
5	77.162	38	586.429	71	1095.70
6	92.594	39	601 862	72	1111.13
7	108.026	40	617.294	73	1126.56
8	123.459	41	632.726	74	1141.99
9	138.891	42	648.159	75	1157.43
10	154.323	43	663.591	76	1172.86
11	169.756	44	679.025	77	1188.29
12	185.188	45	694.456	78	1203 72
13	200.620	46	709.888	79	1219.16
14	216.053	47	725.320	80	1234.588
15	231.485	48	740.753	81	1250.02
16	246.917	49	756.185	82	1265.45
17	262 350	50	771.617	83	1280.88
18	277.782	51	787.050	84	1296 32
19	293.214	52	802.462	85	1311.75
20	308.647	53	817.914	86	1327.18
21	324.079	54	833.347	87	1342.61
22	339.511	55	848.779	88	1358.05
23	354 943	56	864.211	89	1373.48
24	370.376	57	879.644	90	1388.911
25	385.808	58	895.076	91	1404.34
26	401.241	59	910.508	92	1419.78
27	416.673	60	925.941	93	1435.21
28	432.106	61	941.373	94	1450.64
29	447.538	62	956.806	95	1466.07
30	462.970	63	972.238	96	1481.51
31	478.403	64	987.670	97	1496.94
32	493.835	65	1003.10	98	1512.37
33	509.267	66	1018.53	99	1527.80

GRAINS TO GRAMMES.

G.	Grammes.	G.	Grammes.	G.	Grammes.
1	.065	34	2.203	67	4.341
2	.130	35	2.268	68	4.406
3	.194	36	2.333	69	4.471
4	.259	37	2.398	70	4.536
5	.324	38	2.462	71	4.601
6	.389	39	2.527	72	4.666
7	.454	40	2 592	73	4.730
8	.518	41	2.657	74	4.795
9	.583	42	2.722	75	4.860
10	.648	43	2.786	76	4.925
11	.713	44	2.851	77	4.989
12	.778	45	2.916	78	5.054
13	.842	46	2.981	79	5.119
14	.907	47	3.046	80	5.184
15	.972	48	3.110	81	5.249
16	1.037	49	3.175	82	5.313
17	1.102	50	3.240	83	5.378
18	1.166	51	3.305	84	5.443
19	1.231	52	3.370	85	5.508
20	1.296	53	3.434	86	5.573
21	1.361	54	3.499	87	5.637
22	1.426	55	3.564	88	5.702
23	1.490	56	3 629	89	5.767
24	1.555	57	3.694	90	5.832
25	1.620	58	3.758	91	5.897
26	1.685	59	3.823	92	5.961
27	1.750	60	3.888	93	6.026
28	1.814	61	3.953	94	6.091
29	1.879	62	4.018	95	6.156
30	1.944	63	4.082	96	6.221
31	2 009	64	4.147	97	6.285
32	2.074	65	4 212	98	6.350
33	2.138	66	4.277	99	6.415

KILOGRAMMES TO POUNDS AVOIRDUPOIS.

K.	Pounds.	K.	Pounds.	K.	Pounds.
1	2.205	34	74.957	67	147.710
2	4.409	35	77.162	68	149.914
3	6.614	36	79.366	69	152.119
4	8.818	37	81.571	70	154.323
5	11.023	38	83.776	71	156.258
6	13.228	39	85.980	72	158.733
7	15.432	40	88.185	73	160.937
8	17.637	41	90.389	74	163.142
9	19.842	42	92.594	75	165.347
10	22.046	43	94.799	76	167.551
11	24.251	44	97.003	77	169.756
12	26.455	45	99.208	78	171.960
13	28.660	46	101.413	79	174.165
14	30.865	47	103.617	80	176.370
15	33.069	48	105.822	81	178.574
16	35.274	49	108.026	82	180.779
17	37.478	50	110.231	83	182.984
18	39.683	51	112.436	84	185.188
19	41.887	52	114.640	85	187.393
20	44.092	53	116.845	86	189.597
21	46.297	54	119.050	87	191.802
22	48.502	55	121.254	88	194.007
23	50.706	56	123.459	89	196.211
24	52.911	57	125.663	90	198.416
25	55 116	58	127.868	91	200.620
26	57.320	59	130.073	92	202.825
27	59 525	60	132.277	93	205.030
28	61.729	61	134.482	94	207.234
29	63.934	62	136.686	95	209.439
30	66.139	63	138.891	96	211.644
31	68.343	64	141.096	97	213.848
32	70.548	65	143.300	98	216.053
33	72.753	66	145.505	99	218.258

POUNDS AVOIRDUPOIS TO KILOGRAMMES.

P.	Kilos.	P.	Kilos.	P.	Kilos.
1	.454	34	15.422	67	30.391
2	.907	35	15.876	68	30.844
3	1.361	36	16.329	69	31.298
4	1.814	37	16.783	70	31.751
5	2.268	38	17.236	71	32.205
6	2.722	39	17.690	72	32.659
7	3.175	40	18.144	73	33.112
8	3.629	41	18.597	74	33.566
9	4.082	42	19.051	75	34.019
10	4.536	43	19.504	76	34.473
11	4.990	44	19.958	77	34.927
12	5.443	45	20.412	78	35.380
13	5.897	46	20.865	79	35.834
14	6.350	47	21.319	80	36.287
15	6.804	48	21.772	81	36.741
16	7.257	49	22.226	82	37.195
17	7.711	50	22.680	83	37.648
18	8.165	51	23.133	84	38.102
19	8.618	52	23.587	85	38.555
20	9.072	53	24.040	86	39.009
21	9.525	54	24.494	87	39.463
22	9.979	55	24.948	88	39.916
23	10.432	56	25.401	89	40.370
24	10.886	57	25.855	90	40.823
25	11.340	58	26.308	91	41.277
26	11.793	59	26.762	92	41.730
27	12.247	60	27.216	93	42.184
28	12.700	61	27.669	94	42.638
29	13.154	62	28.123	95	43.091
30	13.608	63	28.576	96	43.545
31	14 061	64	29.030	97	43.998
32	14.515	65	29.483	98	44.452
33	14.969	66	29.937	99	44.906

FRENCH TONS TO ENGLISH TONS.

Fr. T.	Eng. T.	Fr. T.	Eng. T.	Fr. T.	Eng. T.
1	.984	34	33.463	67	65.942
2	1.968	35	34.447	68	66.926
3	2.953	36	35.431	69	67.910
4	3.937	37	36.416	70	68.894
5	4.921	38	37.400	71	69.879
6	5.905	39	38.384	72	70.863
7	6.889	40	39.368	73	71.847
8	7.874	41	40.352	74	72.831
9	8 858	42	41.337	75	73.815
10	9.842	43	42.321	76	74.800
11	10.826	44	43.305	77	75.784
12	11.810	45	44.289	78	76.768
13	12.795	46	45.273	79	77.752
14	13.779	47	46.258	80	78.736
15	14.763	48	47.242	81	79.721
16	15.747	49	48.226	82	80.705
17	16.731	50	49.210	83	81.689
18	17.716	51	50.194	84	82.673
19	18.700	52	51.179	85	83.657
20	19.684	53	52.163	86	84.642
21	20.668	54	53.147	87	85.626
22	21 652	55	54.131	88	86.610
23	22 637	56	55.115	89	87.594
24	23.621	57	56.100	90	88.578
25	24.605	58	57.084	91	89.563
26	25.589	59	58.068	92	90.547
27	26.574	60	59.052	93	91.531
28	27.558	61	60.037	94	92.515
29	28.542	62	61.021	95	93.500
30	29.526	63	62.005	96	94.484
31	30.510	64	62.989	97	95.468
32	31.495	65	63.973	98	96.452
33	32.479	66	64.958	99	97.436

ENGLISH TONS TO FRENCH TONS.

Eng.T.	Fr. T.	Eng.T.	Fr. T.	Eng.T.	Fr. T.
1	1.016	34	34.546	67	68.075
2	2.032	35	35.562	68	69.091
3	3.048	36	36.578	69	70.107
4	4.064	37	37.594	70	71.123
5	5.080	38	38.610	71	72.139
6	6.096	39	39.626	72	73.155
7	7.112	40	40 642	73	74.171
8	8.128	41	41.658	74	75.187
9	9.144	42	42.674	75	76.204
10	10.160	43	43.690	76	77.220
11	11.176	44	44.706	77	78.236
12	12.193	45	45.722	78	79.252
13	13.209	46	46.738	79	80.268
14	14.225	47	47.754	80	81.284
15	15.241	48	48.770	81	82.300
16	16.257	49	49.786	82	83.316
17	17.273	50	50.802	83	84.332
18	18.289	51	51.818	84	85.348
19	19.305	52	52.834	85	86.364
20	20.321	53	53.850	86	87.380
21	21.337	54	54.867	87	88.396
22	22.353	55	55.883	88	89.412
23	23.369	56	56 899	89	90.428
24	24.385	57	57.915	90	91.444
25	25.401	58	58.931	91	92.460
26	26.417	59	59.947	92	93.476
27	27.433	60	60.963	93	94.492
28	28.449	61	61.979	94	95.508
29	29 465	62	62.995	95	96.524
30	30.481	63	64.011	96	97.541
31	31 497	64	65.027	97	98.557
32	32.513	65	66.043	98	99.573
33	33.530	66	67.059	99	100.589

KILOGRAMMES PER CENTIMETRE TO POUNDS PER SQUARE INCH.

K.	Pounds.	K.	Pounds.	K.	Pounds.
1	14.223	34	483.576	67	952.929
2	28.446	35	497.799	68	967.152
3	42.669	36	512.022	69	981.375
4	56.891	37	526.244	70	995.597
5	71.114	38	540.467	71	1009.82
6	85.337	39	554.690	72	1024.04
7	99.560	40	568.913	73	1038.27
8	113.783	41	583.136	74	1052.49
9	128.005	42	597.358	75	1066.71
10	142.228	43	611.581	76	1080.93
11	156.451	44	625.804	77	1095.16
12	170.674	45	640.027	78	1109.38
13	184.897	46	654.250	79	1123.60
14	199.119	47	668.473	80	1137.826
15	213.342	48	682.695	81	1152.05
16	227.565	49	696.918	82	1166.27
17	241.788	50	711.141	83	1180.49
18	256.011	51	725.364	84	1194.72
19	270.234	52	739.587	85	1208.94
20	284.456	53	753.809	86	1223.16
21	298.679	54	768.032	87	1237.39
22	312.902	55	782.255	88	1251.61
23	327.125	56	796 478	89	1265.83
24	341.348	57	810.701	90	1280.054
25	355.571	58	824.924	91	1294.28
26	369.793	59	839.146	92	1308.50
27	384.016	60	853.369	93	1322.72
28	398.239	61	867.592	94	1336.95
29	412.462	62	881.815	95	1351.17
30	426.684	63	896.038	96	1365.39
31	440.907	64	910.260	97	1379.61
32	455.130	65	924 483	98	1393.84
33	469.353	66	938.706	99	1408.06

POUNDS PER SQUARE INCH TO KILOGRAMMES PER CENTIMETRE.

P.	Kilos.	P.	Kilos.	P.	Kilos.
1	.070	34	2.391	67	4.711
2	.141	35	2 461	68	4.781
3	.211	36	2.531	69	4.851
4	.281	37	2.601	70	4.922
5	.352	38	2.672	71	4.992
6	.422	39	2.742	72	5.062
7	.492	40	2.812	73	5.133
8	.563	41	2.883	74	5.203
9	.633	42	2.953	75	5 273
10	.703	43	3.023	76	5.344
11	.773	44	3.094	77	5.414
12	.844	45	3.164	78	5.484
13	.914	46	3.234	79	5.554
14	.984	47	3.305	80	5.625
15	1.054	48	3.375	81	5.695
16	1.125	49	3.445	82	5.765
17	1.195	50	3.515	83	5.836
18	1.266	51	3.586	84	5.906
19	1.336	52	3.656	85	5.976
20	1.406	53	3.726	86	6.047
21	1.476	54	3.797	87	6.117
22	1.547	55	3.867	88	6 187
23	1.617	56	3.937	89	6 258
24	1.687	57	4.008	90	6.328
25	1.758	58	4.078	91	6.398
26	1.828	59	4.148	92	6.468
27	1.898	60	4.219	93	6.539
28	1.969	61	4.289	94	6.609
29	2.039	62	4.359	95	6.679
30	2.109	63	4.430	96	6.750
31	2.180	64	4.500	97	6.820
32	2.250	65	4.570	98	6.890
33	2.320	66	4.640	99	6.961

FRENCH HORSE-POWER TO ENGLISH HORSE-POWER.

Fr.	English.	Fr.	English.	Fr.	English.
1	.986	34	33.535	67	66.085
2	1.973	35	31.522	68	67.071
3	2.959	36	35.508	69	68.057
4	3.945	37	36.494	70	69.043
5	4.932	38	37.481	71	70.030
6	5.918	39	38.467	72	71.016
7	6.904	40	39 453	73	72.002
8	7.891	41	40.439	74	72.989
9	8.877	42	41.426	75	73.975
10	9.863	43	42.412	76	74 962
11	10.850	44	43.398	77	75.948
12	11.836	45	44.385	78	76.934
13	12.822	46	45.371	79	77 921
14	13.809	47	46.357	80	78.907
15	14.795	48	47.344	81	79.893
16	15.781	49	48.330	82	80.880
17	16.768	50	49.317	83	81.866
18	17.754	51	50.303	84	82.852
19	18.740	52	51.289	85	83.839
20	19.727	53	52.276	86	84.825
21	20.713	54	53.262	87	85.811
22	21.699	55	54.248	88	86.798
23	22.686	56	55 235	89	87.784
24	23.672	57	56.221	90	88.770
25	24.658	58	57.207	91	89.757
26	25.645	59	58.184	92	90.743
27	26.631	60	59.180	93	91.729
28	27.617	61	60.166	94	92.716
29	28.604	62	61.153	95	93 702
30	29.590	63	62.139	96	94.688
31	30.576	64	63.125	97	95 675
32	31 563	65	64.112	98	96.661
33	32.549	66	65.098	99	97.647

ENGLISH HORSE-POWER TO FRENCH HORSE-POWER.

Eng.	French.	Eng.	French.	Eng.	French.
1	1.014	34	34.471	67	67.928
2	2 028	35	35.485	68	68.942
3	3.042	36	36.499	69	69.956
4	4.055	37	37.512	70	70.969
5	5.069	38	38.526	71	71.983
6	6.083	39	39.540	72	72.997
7	7.097	40	40.554	73	74.011
8	8.111	41	41.568	74	75.025
9	9 125	42	42.582	75	76.039
10	10.138	43	43.596	76	77.053
11	11.152	44	44.609	77	78.066
12	12.166	45	45.623	78	79.080
13	13.180	46	46.637	79	80.094
14	14.194	47	47.651	80	81.108
15	15.208	48	48.665	81	82.122
16	16.222	49	49.679	82	83.136
17	17.235	50	50.692	83	84.150
18	18.249	51	51.706	84	85.163
19	19.263	52	52.720	85	86.177
20	20.277	53	53.734	86	87.191
21	21.291	54	54.748	87	88.205
22	22 305	55	55.762	88	89.219
23	23.319	56	56.775	89	90.233
24	24.332	57	57.789	90	91 246
25	25.346	58	58.803	91	92.260
26	26.360	59	59.817	92	93 274
27	27.374	60	60.831	93	94.288
28	28.388	61	61.845	94	95.302
29	29.402	62	62.859	95	96.316
30	30.415	63	63.873	96	97.330
31	31.429	64	64.886	97	98.343
32	32 443	65	65.900	98	99.357
33	33.457	66	66 914	99	100.371

TABLE

OF

SQUARES, CUBES, SQUARE AND CUBE ROOTS OF NUMBERS.

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
1	1	1	1.0000	1.0000
2	4	8	1.4142	1.2599
3	9	27	1.7321	1.4422
4	16	64	2.0000	1.5874
5	25	125	2.2361	1.7100
6	36	216	2.4495	1.8171
7	49	343	2.6458	1.9129
8	64	512	2.8284	2.0000
9	81	729	3.0000	2.0801
10	100	1000	3.1623	2.1544
11	121	1331	3.3166	2.2240
12	144	1728	3.4641	2 2894
13	169	2197	3.6056	2.3513
14	196	2744	3.7417	2.4101
15	225	3375	3.8730	2.4662
16	256	4096	4.0000	2.5198
17	289	4913	4.1231	2.5713
18	324	5832	4.2426	2.6207
19	361	6859	4.3589	2.6684
20	400	8000	4.4721	2.7144

SQUARES, CUBES, SQUARE AND CUBE ROOTS.

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
21	441	9261	4.5826	2.7589
22	484	10648	4.6904	2.8020
23	529	12167	4.7958	2.8439
24	576	13824	4.8990	2.8845
25	625	15625	5.0000	2.9240
26	676	17576	5.0990	2.9625
27	729	19683	5.1962	3.0000
28	784	21952	5.2915	3.0366
29	841	24389	5.3852	3.0723
30	900	27000	5.4772	3 1072
31	961	29791	5.5678	3.1414
32	1024	32768	5.6569	3.1748
33	1089	35937	5.7446	3.2075
34	1156	39304	5 8310	3.2396
35	1225	42875	5.9161	3.2711
36	1296	46656	6.0000	3.3019
37	1369	50653	6.0828	3.3322
38	1444	54872	6.1644	3.3620
39	1521	59319	6.2450	3.3912
40	1600	64000	6,3246	3.4200
41	1681	68921	6.4031	3.4482
42	1764	74088	6.4807	3.4760
43	1849	79507	6.5574	3.5034
44	1936	85184	6.6332	3.5303
45	2025	91125	6.7082	3.5569
46	2116	97336	6.7823	3.5830
47	2209	103823	6.8557	3.6088
48	2304	110592	6.9282	3.6342
49	2401	117649	7.0000	3.6593
50	2500	125000	7.0711	3.6840
51	2601	132651	7.1414	3 7084
52	2704	140608	7.2111	3.7325
53	2809	148877	7.2801	3.7563

SQUARES, CUBES, SQUARE AND CUBE ROOTS.

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
54	2916	157464	7.3485	3.7798
55	3025	166375	7.4162	3.8030
56	3136	175616	7.4833	3.8259
57	3249	185193	7.5498	3.8485
58	3364	195112	7.6158	3.8709
59	3481	205379	7.6811	3.8930
60	3600	216000	7.7460	3.9149
61	3721	226981	7.8102	3.9305
62	3844	238328	7.8740	3.9579
63	3969	250047	7.9373	3.9791
64	4096	262144	8.0000	4.0000
65	4225	274625	8.0623	4.0207
66	4356	287496	8.1240	4.0412
67	4489	300763	8.1854	4.0615
68	4624	314432	8.2462	4.0817
69	4761	328509	8.3066	4.1016
70	4900	343000	8.3666	4.1213
71	5041	357911	8.4261	4.1408
72	5184	373248	8.4853	4.1602
73	5329	389017	8.5440	4.1793
74	5476	405224	8.6023	4 1983
75	5625	421875	8.6603	4.2172
76	5776	438976	8.7178	4.2358
77	5929	456533	8.7750	4 2543
78	6084	474552	8.8318	4.2727
79	6241	493039	8.8882	4.2908
80	6400	512000	8.9443	4.3089
81	6561	531441	9.0000	4.3267
82	6724	551368	9.0554	4.3445
83	6889	571787	9.1104	4.3621
84	7056	592704	9.1652	4.3795
85	7225	614125	9.2195	4.3968
86	7396	636056	9.2736	4.4140

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
87	7569	658503	9.3274	4.4310
88	7744	681472	9.3808	4.4471
89	7921	704969	9.4340	4.4647
90	8100	729000	9.4868	4.4814
91	8281	753571	9.5394	4.4979
92	8464	778688	9.5917	4.5144
93	8649	804357	9.6437	4.5307
94	8836	830584	9.6954	4.5468
95	9025	857374	9.7468	4.5629
96	9216	884736	9.7980	4.5789
97	9409	912673	9.8489	4.5947
98	9604	941192	9.8995	4.6104
99	9801	970299	9.9499	4.6261
100	10000	1000000	10.0000	4.6416
101	10201	1030301	10.0499	4.6570
102	10404	1061208	10.0995	4.6723
103	10609	1092727	10.1489	4.6875
104	10816	1124864	10.1980	4.7027
105	11025	1157625	10.2470	4.7177
106	11236	1191016	10.2956	4.7326
107	11449	1225043	10.3441	4.7475
108	11664	1259712	10.3923	4.7622
109	11881	1295029	10.4403	4.7769
110	12100	1331000	10.4881	4.7914
111	12321	1367631	10.5357	4.8059
112	12544	1404928	10.5830	4.8203
113	12769	1442897	10.6301	4.8346
114	12996	1481544	10.6771	4.8488
115	13225	1520875	10.7238	4.8629
116	13456	1560896	10.7703	4.8770
117	13689	1601613	10.8167	4.8910
118	13924	1643032	10.8628	4.9049
119	14161	1685159	10.9087	4.9187

SQUARES, CUBES, SQUARE AND CUBE ROOTS.

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
120	14400	1728000	10.9545	4.9324
121	14641	1771561	11.0000	4.9461
122	14834	1815848	11.0454	4.9597
123	15129	1860867	11.0905	4.9732
124	15376	1906624	11.1355	4.9866
125	15625	1953125	11.1803	5.0000
126	15876	2000376	11.2250	5.0133
127	16129	2048383	11.2694	5.0265
128	16384	2097152	11.3137	5 0397
129	16641	2146689	11.3578	5.0528
130	16900	2197000	11.4018	5.0658
131	17161	2248091	11.4455	5.0788
132	17424	2299968	11 4891	5.0916
133	17689	2352637	11.5326	5.1045
134	17956	2406104	11.5758	5.1172
135	18225	2460375	11.6189	5.1299
136	18496	2515456	11.6619	5.1426
137	18769	2571353	11.7047	5.1551
138	19044	2628072	11.7473	5.1676
139	19321	2685619	11.7898	5.1801
140	19600	2744000	11.8322	5.1925
141	19881	2803221	11.8743	5.2048
142	20164	2863288	11.9164	5.2171
143	20449	2924207	11.9583	5.2293
144	20736	2985984	12.0000	5.2415
145	21025	3048625	12.0416	5.2536
146	21316	3112136	12.0830	5.2656
147	21609	3176523	12.1244	5.2776
148	21904	3241792	12.1655	5.2896
149	22201	3307949	12.2066	5.3015
150	22500	3375000	12.2474	5.3133
151	22801	3442951	12.2882	5.3251
152	23104	3511008	12.3288	5.3368

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
153	23409	3581577	12.3693	5 3485
154	23716	3652264	12.4097	5.3601
155	24025	3723875	12.4499	5.3717
156	24336	3796416	12.4900	5.3832
157	24649	3869893	12.5300	5.3947
158	24964	3944312	12.5698	5.4061
159	25281	4019679	12.6095	5 4175
160	25600	4096000	12.6491	5.4288
161	25921	4173281	12.6886	5.4401
162	26244	4251528	12.7279	5.4514
163	26569	4330747	12.7671	5.4626
164	26896	4410944	12.8062	5.4737
165	27225	4492125	12.8452	5 4848
166	27556	4574296	12.8841	5.4959
167	27889	4657463	12.9228	5.5069
168	28224	4741632	12.9615	5.5178
169	28561	4826809	13.0000	5.5288
170	28900	4913000	13.9384	5.5397
171	29241	5000211	13.0767	5.5505
172	29584	5088448	13.1149	5.5613
173	29929	5177717	13.1529	5.5721
174	30276	5268024	13 1909	5.5828
175	30625	5359375	13.2288	5.5934
176	30976	5451776	13.2665	5.6041
177	31329	5545233	13.3041	5.6147
178	31684	5639752	13.3417	5.6252
179	32041	5735339	13.3791	5 6357
180	32400	5832000	13.4164	5.6462
181	32761	5929741	13.4536	5.6567
182	33124	6028568	13.4907	5.6671
183	33489	6128487	13.5277	5.6774
184	33856	6229504	13.6647	5.6877
185	34225	6331625	13.6015	5 6980

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
186	34596	6434856	13.6382	5.7083
187	34969	6539203	13.6748	5.7185
188	35344	6644672	13.7113	5.7287
189	35721	6751269	13.7477	5.7388
190	36100	6859000	13.7840	5 7489
191	36481	6967871	13.8203	5.7590
192	36864	7077888	13.8564	5 7690
193	37249	7189517	13.8924	5.7790
194	37636	7301384	13.9284	5.7890
195	38025	7414875	13.9642	5.7989
196	38416	7529536	14 0000	5.8088
197	38809	7645373	14.0357	5.8186
198	39204	7762392	14.0712	5.8285
199	39601	7880599	14.1067	5.8383
200	40000	8000000	14.1421	5.8480
201	40401	8120601	14.1774	5.8578
202	40804	8242408	14.2127	5.8675
203	41209	8365427	14.2478	5.8771
204	41616	8489664	14.2829	5.8868
205	42025	8615125	14.3178	5.8964
206	42436	8741816	14.3527	5.9059
207	42849	8869743	14.3875	5 9155
208	43264	8998912	14.4222	5 9250
209	43681	9129329	14 4568	5.9345
210	44100	9261000	14.4914	5.9439
211	44521	9393931	14.5258	5 9533
212	44944	9528128	14.5602	5 9627
213	45369	9663597	14.5945	5.9721
214	45796	9800344	14.6287	5.9814
215	46225	9938375	14.6629	5 9907
216	46656	10077696	14.6969	6.0000
217	47089	10218312	14.7309	6.0092
218	47524	10360232	14.7648	6.0185

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
219	47961	10503459	14.7986	6.0277
220	48400	10648000	14.8324	6.0368
221	48841	10793861	14.8661	6.0459
222	49284	10941048	14 8997	6.0550
223	49729	11089567	14.9332	6.0641
224	50176	11239424	14.9666	6.0732
225	50625	11390625	15.0000	6.0824
226	51076	11543176	15.0333	6.0992
227	51529	11697083	15.0665	6.1002
228	51984	11852352	15 0997	6.1091
229	52441	12008989	15.1327	6.1180
230	52900	12167000	15.1658	6.1269
231	53361	12326391	15.1987	6.1358
232	53824	12487168	15.2315	6.1446
233	54289	12649337	15.2643	6 1534
234	54756	12812904	15.2971	6.1622
235	55225	12977875	15.3297	6.1710
236	55696	13144256	15.3623	6.1797
237	56169	13312053	15.3948	6.1885
238	56644	13481272	15.4272	6.1972
239	57121	13651919	15 4596	6.2058
240	57600	13824000	15.4919	6.2145
241	58081	13997521	15.5242	6.2231
242	58564	14172488	15.5563	6.2317
243	59049	14348907	15.5885	6.2403
244	59536	14526784	15.6205	6.2488
245	60025	14706125	15.6525	6.2573
246	60516	14886936	15.6844	6.2658
247	61009	15069223	15.7162	6.2743
248	61504	15252992	15.7480	6.2828
249	62001	15438249	15 7797	6.2912
250	62500	15625000	15.8114	6.2996
251	63001	15813251	15.8430	6.3080

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
252	63504	16003008	15.8745	6.3164
253	64009	16194277	15.9060	6.3247
254	64516	16387064	15.9374	6.3330
255	65025	16581375	15.9687	6.3413
256	65536	167772l6	16.0000	6.3496
257	66049	16974593	16.0312	6.3579
258	66564	17173512	16.0624	6.3661
259	67081	17373979	16.0935	6.3743
260	67600	17576000	16.1245	6.3825
261	68121	17779581	16.1555	6.3907
262	68644	17984728	16.1864	6.3988
263	69169	18191447	16.2173	6.4070
264	69696	18399744	16.2481	6.4151
265	70225	18609625	16.2788	6.4232
266	70756	18821096	16.3095	6.4312
267	71289	19034163	16.3401	6.4393
268	71824	19248832	16.3707	6.4473
269	72361	19465109	16.4012	6.4553
270	72900	19683000	16.4317	6.4633
271	73441	19902511	16.4621	6.4713
272	73984	20123643	16.4924	6.4792
273	74529	20346417	16.5227	6.4872
274	75076	20570824	16.5529	6.4951
275	75625	20796875	16.5831	6.5030
276	76176	21024576	16.6132	6.5108
277	76729	21253933	16.6433	6.5187
278	77284	21484952	16.6783	6.5265
279	77841	21717639	16.7033	6.5343
280	78400	21952000	16.7332	6.5421
281	78961	22188041	16.7631	6.5499
282	79524	22425768	16.7929	6.5577
283	80089	22665187	16.8226	6 5654
284	80656	22906304	16.8523	6.5731

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
285	81225	23149125	16.8819	6.5808
286	81796	23393656	16.9115	6.5885
287	82369	23639903	16.9411	6.5962
288	82944	23887872	16.9706	6.6039
289	83521	24137569	17.0000	6.6115
290	84100	24389000	17.0294	6.6191
291	84681	24642171	17.0587	6.6267
292	85264	24897088	17.0880	6.6343
293	85849	25153757	17.1172	6.6419
294	86436	25412184	17.1464	6.6494
295	87025	25672375	17.1756	6.6569
296	87616	25934836	17.2047	6.6644
297	88209	26198073	17.2337	6.6719
298	88804	26463592	17.2627	6.6794
299	89401	26730899	17.2916	6.6869
300	90000	27000000	17.3205	6.6943
301	90601	27270901	17.3494	6.7018
302	91204	27543608	17.3781	6.7092
303	91809	27818127	17.4069	6.7166
304	92416	28094464	17.4356	6.7240
305	93025	28372625	17.4642	6.7313
306	93636	28652616	17.4929	6.7387
307	94249	28934443	17.5214	6.7460
308	94864	29218112	17.5499	6.7533
309	95481	29503609	17.5784	6.7606
310	96100	29791000	17.6068	6.7679
311	96721	30080231	17.6352	6.7752
312	97344	30371328	17.6635	6.7824
313	97969	30664297	17.6918	6.7897
314	98596	30959144	17.7200	6.7969
315	99225	31255875	17 7482	6.8041
316	99856	31554496	17.7764	6.8113
317	100489	31855013	17.8045	6.8185

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
318	101124	32157432	17.8326	6.8256
319	101761	32461759	17.8606	6.8328
320	102400	32768000	17.8885	6.8399
321	103041	33076161	17.9165	6.8470
322	103684	33386248	17.9444	6.8541
323	104329	33698267	17.9722	6.8612
324	104976	34012224	18.0000	6.8683
325	105625	34328125	18.0278	6.8753
326	106276	34645976	18.0555	6.8824
327	106929	34965783	18.0831	6.8894
328	107584	35287552	18.1108	6.8964
329	108241	35611289	18.1384	6.9034
330	108900	35937000	18.1659	6.9104
331	109561	36264691	18.1934	6.9174
332	110224	36594368	18.2209	6.9244
333	110889	36926037	18.2483	6.9313
334	111556	37259704	18.2757	6.9382
335	112225	37595375	18.3030	6.9451
336	112896	37933056	18.3303	6.9521
337	113569	38272753	18.3576	6.9589
338	114244	38614472	18.3848	6.9658
339	114921	38958219	18.4120	6.9727
340	115600	39304000	18.4391	6.9795
341	116281	39651821	18.4662	6.9864
342	116964	40001688	18.4932	6.9932
343	117649	40353607	18.5203	7.0000
344	118336	40707584	18.5472	7.0068
345	119025	41063625	18.5742	7.0136
346	119716	41421736	18.6011	7.0203
347	120409	41781923	18.6279	7.0271
348	121104	42144192	18.6548	7.0338
349	121801	42508549	18.6815	7.0406
350	122500	42875000	18.7083	7.0473

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
351	123201	43243551	18.7350	7.0540
352	123904	43614208	18.7617	7.0607
353	124609	43986977	18.7883	7.0674
354	125316	44361864	18.8149	7.0740
355	126025	44738875	18.8414	7.0807
356	126736	45118016	18.8680	7.0873
357	127449	45499293	18.8944	7 0940
358	128164	45882712	18.9209	7.1006
359	128881	46268279	18.9473	7.1072
360	129600	46656000	18.9737	7.1138
361	130321	47045831	19.0000	7.1204
362	131044	47437928	19.0263	7.1269
363	131769	47832147	19.0526	7.1335
364	132496	48228544	19.0788	7.1400
365	133225	48627125	19.1050	7.1466
366	133956	49027896	19.1311	7.1531
367	134689	49430863	19.1572	7.1596
368	135424	49836032	19.1833	7.1661
369	136161	50243409	19.2094	7.1726
370	136900	50653000	19.2354	7.1791
371	137641	51064811	19.2614	7.1855
372	138384	51478848	19.2873	7.1920
373	139129	51895117	19.3132	7.1984
374	139876	52313624	19.3391	7.2048
375	140625	52734375	19.3649	7.2112
376	141376	53157376	19.3907	7.2177
377	142129	53582633	19.4165	7.2240
378	142884	54010152	19.4422	7.2304
379	143641	54439939	19.4679	7.2368
380	144400	54872000	19.4936	7.2432
381	145161	55306341	19.5192	7.2495
382	145924	55742968	19 5448	7.2558
383	146689	56181887	19.5704	7.2622

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
384	147456	56623104	19.5959	7.2685
385	148225	57066625	19.6214	7.2748
386	148996	57512456	19.6469	7.2811
387	149769	57960603	19.6723	7.2874
388	150544	58411072	19.6977	7.2936
389	151321	58863869	19.7231	7.2999
390	152100	59319000	19.7484	7.3061
391	152881	59776471	19.7737	7.3124
392	153664	60236288	19.7990	7.3186
393	154449	60698457	19.8242	7 3248
394	155236	61162984	19.8494	7.3310
395	156025	61629875	19.8746	7.3372
396	156816	62099136	19.8997	7.3434
397	157609	62570773	19.9249	7.3496
398	158404	63044792	19.9499	7.3558
399	159201	63521199	19.9750	7.3619
400	160000	64000000	20.0000	7.3681
401	160801	64481201	20.0250	7.3742
402	161604	64964808	20.0499	7.3803
403	162409	65450827	20.0749	7.3864
404	163216	65939264	20.0998	7.3925
405	164025	66430125	20.1246	7.3986
406	164836	66923416	20.1494	7.4047
407	165649	67419143	20.1742	7.4108
408	166464	67917312	20.1990	7.4169
409	167281	68417929	20.2237	7.4229
410	168100	68921000	20.2485	7.4290
411	168921	69426531	20.2731	7.4350
412	169744	69934528	20.2978	7.4410
413	170569	70444997	20.3224	7.4470
414	171396	70957944	20.3470	7.4530
415	172225	71473375	20.3715	7.4590
416	173056	71991296	20.3961	7.4650

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
417	173889	72511713	20.4206	7 4710
418	174724	73034632	20.4450	7.4770
419	175561	73560059	20.4695	7.4829
420	176400	74088000	20.4939	7.4889
421	177241	74618461	20.5183	7.4948
422	178084	75151448	20.5426	7.5007
423	178929	75686967	20.5670	7 5067
424	179776	76225024	20.5913	7.5126
425	180625	76765625	20.6155	7.5185
426	181476	77308776	20.6398	7.5244
427	182329	77854483	20.6640	7.5302
428	183184	78402752	20.6882	7 5361
429	184041	78953589	20.7123	7.5420
430	184900	79507000	20.7364	7.5478
431	185761	80062991	20.7605	7.5537
432	186624	80621568	20.7846	7.5595
433	187489	81182737	20.8087	7.5054
434	188356	81746504	20.8327	7.5712
435	189225	82312875	20.8567	7.5770
436	190096	82881856	20.8806	7.5828
437	190969	83453453	20.9045	7.5886
438	191844	84027672	20.9284	7.5944
439	192721	84604519	20.9523	7.6001
440	193600	85184000	20.9762	7.6059
441	194481	85766121	21.0000	7.6117
442	195364	86350888	21.0238	7.6174
443	196249	86938307	21.0476	7 6232
444	197136	87528384	21.0713	7.6289
445	198025	88121125	21.0950	7.6346
446	198916	88716536	21.1187	7.6403
447	199809	89314623	21.1424	7.6460
448	200704	89915392	21.1660	7.6517
449	201601	90518849	21.1896	7.6574

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
450	202500	91125000	21.2132	7.6631
451	203401	91733851	21.2368	7.6688
452	204304	92345408	21.2603	7.6744
453	205209	92959677	21.2838	7.6801
454	206116	93576664	21.3073	7.6857
455	207025	94196375	21.3307	7.6914
456	207936	94818816	21.3542	7 6970
457	208849	95443993	21.3776	7.7026
458	209764	96071912	21.4009	7.7082
459	210681	96702579	21.4243	7.7188
460	211600	97336000	21 4476	7.7194
461	212521	97972181	21.4709	7.7250
462	213444	98611128	21.4942	7.7306
463	214369	99252847	21.5174	7.7362
464	215296	99897344	21.5407	7.7418
465	216225	100544625	21.5639	7.7473
466	217156	101194696	21.5870	7.7529
467	218089	101847563	21.6102	7.7584
468	219024	102503232	21.6333	7.7639
469	219961	103161709	21.6564	7.7695
470	220900	103823000	21 6795	7.7750
471	221841	104487111	21.7025	7 7805
472	222784	105154048	21.7256	7.7860
473	223729	105828817	21.7486	7.7915
474	224676	106496424	21.7715	7.7970
475	225625	107171875	21.7945	7.8025
476	226576	107850176	21.8174	7.8079
477	227529	108531333	21.8403	7.8134
478	228484	109215352	21.8632	7.8188
479	229441	109902239	21.8861	7.8243
480	230400	110592000	21.9089	7.8297
481	231361	111284641	21.9317	7.8352
482	232324	111980168	21.9545	7.8406

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
483	233289	112678587	21.9773	7.8460
484	234256	113379904	22.0000	7.8514
485	235225	114084125	22.0227	7.8568
486	236196	114791256	22 0454	7.8622
487	237169	115501303	22.0681	7.8676
488	238144	116214272	22.0907	7.8730
489	239121	116930169	22.1133	7.8784
490	240100	117649000	22.1359	7.8837
491	241081	118370771	22.1585	7.8891
492	242064	119095488	22 1811	7.8944
493	243049	119823157	22.2036	7.8998
494	244036	120553784	22.2261	7.9051
495	245025	121287375	22.2486	7.9105
496	246016	122023936	22.2711	7.9158
497	247009	122763473	22.2935	7 9211
498	248004	123505992	22.3159	7.9264
499	249001	124251499	22.3383	7.9317
500	250000	125000000	22.3607	7.9370
501	251001	125751501	22.3830	7.9423
502	252004	126506008	22.4054	7.9476
503	253009	127263527	22 4277	7.9528
504	254016	128024064	22.4499	7.9581
505	255025	128787625	22 4722	7.9634
506	256036	129554216	22.4944	7.9686
507	257049	130323843	22.5167	7.9739
508	258064	131096512	22.5389	7.9791
509	259081	131872229	22.5610	7.9843
510	260100	132651000	22.5832	7.9895
511	261121	133432831	22.6053	7.9948
512	262144	134217728	22.6274	8.0000
513	263169	135005697	22 6495	8.0052
514	264196	135796744	22.6716	8.0104
515	265225	136590875	22.6936	8.0156

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
516	266256	137388096	22.7156	8.0208
517	267289	138188413	22.7376	8.0260
518	268324	138991832	22.7596	8.0311
519	269361	139798359	22.7816	8 0363
520	270400	140608000	22.8035	8 0415
521	271411	141420761	22.8254	8.0466
522	272484	142236648	22.8473	8.0517
523	273529	143055667	22.8692	8.0569
524	274576	143877824	22.8910	8.0620
525	275625	144703125	22.9129	8.0671
526	276676	145531576	22.9347	8.0723
527	277729	146363183	22.9565	8.0774
528	278784	147197952	22 9783	8.0825
529	279841	148035889	23 0000	8.0876
530	280900	148877001	23.0217	8.0927
531	281961	149721291	23.0434	8.0978
532	283024	150568768	23.0651	8.1028
533	284089	151419437	23.0868	8.1079
534	285156	152273304	23.1084	8.1130
535	286225	153130375	23.1301	8.1180
536	287296	153990656	23.1517	8.1231
537	288369	154854153	23.1733	8.1281
538	289444	155720872	23.1948	8.1332
539	290521	156590819	23.2164	8.1382
540	291600	157464000	23.2379	8.1433
541	292681	158340421	23.2594	8.1483
542	293764	159220088	23.2809	8.1533
543	294849	160103007	23.3024	8.1583
544	295936	160989184	23.3238	8.1633
545	297025	161878625	23.3452	8.1683
546	298116	162771336	23.3666	8.1733
547	299209	163667323	23.3880	8.1783
548	300304	164566592	23.4094	8.1833

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
549	301401	165469149	23.4307	8.1882
550	302500	166375000	23.4521	8.1932
551	303601	167284151	23.4734	8.1982
552	304704	168196608	23.4947	8.2031
553	305809	169112377	23.5160	8.2081
554	306916	170031464	23.5372	8.2130
555	308025	170953875	23 5584	8.2180
556	309136	171879616	23.5797	8.2229
557	310249	172808693	23.6008	8.2278
558	311364	173741112	23 6220	8.2327
559	312481	174676879	23.6432	8.2377
560	313600	175616000	23.6643	8.2426
561	314721	176558481	23.6854	8.2475
562	315844	177504328	23.7065	8.2524
563	316969	178453547	23.7276	8.2573
564	318096	179406144	23.7487	8.2621
565	319225	180362125	23.7697	8.2670
566	320356	181321496	23.7908	8.2719
567	321489	182284263	23.8118	8.2768
568	322624	183250432	23.8328	8.2816
569	323761	184220009	23 8537	8.2865
570	324900	185193000	23.8747	8.2913
571	326041	186169411	23.8956	8.2962
572	327184	187149248	23.9165	8.3010
573	328329	188132517	23.9374	8.3059
574	329476	189119224	23.9583	8.3107
575	330625	190109375	23.9792	8.3155
576	331776	191102976	24.0000	8.3203
577	332927	192100033	24.0208	8.3251
578	334084	193100552	24.0416	8.3300
579	335241	194104539	24.0624	8.3348
580	336400	195112000	24.0832	8.3396
581	337561	196122941	24.1039	8.3443

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
582	338724	197137368	24.1247	8.3491
583	339889	198155287	24.1454	8.3539
584	341056	199176704	24 1661	8.3587
585	342225	200201625	24.1868	8.3634
586	343396	201230056	24.2074	8.3682
587	344569	202262003	24.2281	8.3730
588	345744	203297472	24.2487	8.3777
589	346921	204336469	24.2693	8.3825
590	348100	205379000	24.2899	8.3872
591	349281	206425071	24.3105	8.3919
592	350464	207474688	24.3311	8.3967
593	351649	208527857	24.3516	8.4014
594	352836	209584584	24.3721	8.4061
595	354025	210644875	24.3926	8.4108
596	355216	211708736	24.4131	8.4155
597	356409	212776173	24.4336	8.4202
598	357604	213847192	24.4540	8.4249
599	358801	214921799	24.4745	8.4296
600	360000	216000000	24.4949	8.4343
601	361201	217081801	24.5153	8.4390
602	362404	218167208	24.5357	8.4437
603	363609	219256227	24 5561	8.4484
604	364816	220348864	24 5764	8.4530
605	366025	221445125	24.5967	8.4577
606	367236	222545016	24.6171	8.4623
607	368449	223648543	24.6374	8.4670
608	369664	2247557I2	24.6577	8.4716
609	370881	225866529	24.6779	8.4763
610	372100	226981000	24.6982	8.4809
611	373321	228099131	24.7184	8.4856
612	374544	229220928	24 7386	8.4902
613	375769	230346397	24.7588	8.4948
614	376996	231475544	24.7790	8.4994

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
615	378225	232608375	24.7992	8 5040
616	379456	233744896	24.8193	8.5086
617	380689	234885113	24.8395	8.5132
618	381924	236029032	24.8596	8.5178
619	383161	237176659	24.8797	8.5224
620	384400	238328000	24.8998	8.5270
621	385641	239483061	24.9199	8.5316
622	386884	240641848	24.9399	8.5362
623	388129	241804367	24.9600	8.5408
624	389376	242970624	24.9800	8.5453
625	390625	244140625	25.0000	8.5499
626	391876	245314376	25.0200	8.5544
627	393129	246491883	25.0400	8.5590
628	394384	247673152	25.0599	8.5635
629	395641	248858189	25.0799	8.5681
630	396900	250047000	25.0998	8.5726
631	398161	251239591	25.1197	8.5772
632	399424	252435968	25.1396	8.5817
633	400689	253636137	25.1595	8.5862
634	401956	254840104	25.1794	8.5907
635	403225	256047875	25.1992	8.5952
636	404496	257259456	25.2190	8.5997
637	405769	258474853	25.2389	8.6043
638	407044	259694072	25.2587	8.6088
639	408321	260917119	25.2784	8.6132
640	409600	262144000	25.2982	8.6177
641	410881	263374721	25.3180	8.6222
642	412164	264609288	25.3377	8.6267
643	413449	265847707	25.3574	8.6312
644	414736	267089984	25.3772	8.6357
645	416125	268336125	25.3969	8.6401
646	417316	269585136	25.4165	8 6446
647	418609	270840023	25.4362	8.6490

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
648	419904	272097792	25.4558	8.6535
649	421201	273359449	25.4755	8.6579
650	422500	274625000	25.4951	8.6624
651	423801	275894451	25.5147	8.6668
652	425104	277167808	25.5343	8.6713
653	426409	278445077	25.5539	8.6757
654	427716	279726264	25.5734	8.6801
655	429025	281011375	25.5930	8.6845
656	430336	282300416	25.6125	8.6890
657	431639	283593393	25.6320	8.6934
658	432964	284890312	25.6515	8.6978
659	434281	286191179	25.6710	8.7022
660	435600	287496000	25.6905	8.7066
661	436921	288804781	25.7099	8.7110
662	438244	290117528	25.7294	8.7154
663	439569	291434247	25.7488	8.7198
664	440896	292754944	25.7682	8.7241
665	442225	294079625	25.7876	8.7285
666	443556	295408296	25.8070	8.7329
667	444889	296740963	25.8263	8.7373
668	446224	298077632	25.8457	8.7416
669	447561	299418309	25.8650	8.7460
670	448900	300763000	25.8844	8.7503
671	450241	302111711	25.9037	8.7547
672	451584	303464448	25.9230	8.7590
673	452929	304821217	25.9422	8.7634
674	454276	306182024	25.9615	8.7677
675	455625	307546875	25.9808	8.7721
676	456976	308915776	26.0000	8.7764
677	458329	310288733	26.0192	8.7807
678	459684	311665752	26.0384	8.7850
679	461041	313046839	26.0576	8.7893
680	462400	314432000	26.0768	8.7937

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
681	463761	315821241	26.0960	8.7980
682	465124	317214568	26.1151	8 8023
683	466489	318611987	26.1343	8 8066
684	467856	320013504	26.1534	8.8109
685	469225	321419125	26.1725	8.8152
686	470596	322828856	26.1916	8.8194
687	471969	324242703	26.2107	8.8237
688	473344	325660672	26.2298	8.8280
689	474721	327082769	26.2488	8.8323
690	476100	328509000	26.2679	8 8366
691	477481	329939371	26.2869	8.8408
692	478864	331373888	26.3059	8.8451
693	480249	332812557	26.3249	8.8493
694	481636	334255384	26.3439	8.8536
695	483025	335702375	26.3629	8.8578
696	484416	337153536	26.3818	8.8621
697	485809	338608873	26.4008	8.8663
698	487204	340068392	26.4197	8.8706
699	488601	341532099	26.4386	8.8748
700	490000	343000000	26.4575	8.8790
701	491401	344472101	26.4764	8.8833
702	492804	345948408	26.4953	8.8875
703	494209	347428927	26.5141	8.8917
704	495616	348913664	26.5330	8.8959
705	497025	350402625	26.5518	8.9001
706	498436	351895816	26.5707	8.9043
707	499849	353393243	26.5895	8.9085
708	501264	354894912	26.6083	8.9127
709	502681	356400829	26.6271	8.9169
710	504100	357911000	26.6458	8.9211
711	505521	359425431	26 6646	8.9253
712	506944	360944128	26.6833	8.9295
713	508369	362467097	26.7021	8.9337

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
714	509796	363994344	26.7208	8.9378
715	511225	365525875	26.7395	8.9420
716	512656	367061696	26.7582	8.9462
717	514089	368601813	26.7769	8.9503
718	515524	370146232	26.7955	8 9545
719	516961	371694959	26.8142	8.9587
720	518400	373248000	26.8328	8.9628
721	519841	374805361	26.8514	8.9670
722	521284	376367048	26.8701	8.9711
723	522729	377933067	26.8887	8.9752
724	524176	379503424	26.9072	8.9794
725	525625	381078125	26.9258	8.9835
726	527076	382657176	26.9444	8.9876
727	528529	384240583	26.9629	8.9918
728	529984	385828352	26.9815	8.9959
729	531441	387420489	27.0000	9.0000
730	532900	389017000	27.0185	9.0041
731	534361	390617891	27.0370	9.0082
732	535824	392223168	27.0555	9.0123
733	537289	393832837	27.0740	9.0164
734	538756	395446904	27 0924	9.0205
735	540225	397065375	27.1109	9.0246
736	541696	398688256	27.1293	9.0287
737	543169	400315553	27.1477	9 0328
738	544644	401947272	27.1662	9.0369
739	546121	403583419	27.1846	9.0410
740	547600	405224000	27.2029	9.0450
741	549801	406869021	27.2213	9.0491
742	550564	408518488	27.2397	9.0532
743	552049	410172407	27.2580	9.0572
744	553536	411830784	27.2764	9.0613
745	555025	413493625	27.2947	9 0654
746	556516	415160936	27.3130	9.0694

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
747	558009	416832723	27.3313	9.0735
748	559504	418508992	27.3496	9.0775
749	561001	420189749	27.3679	9.0816
750	562500	421875000	27.3861	9.0856
751	564001	423564751	27.4044	9.0896
752	565504	425259008	27.4226	9.0937
753	567009	426957777	27.4408	9 0977
754	568516	428661064	27.4591	9.1017
755	570025	430368875	27.4773	9.1057
756	571536	432081216	27.4955	9.1098
757	573049	433798093	27.5136	9.1138
758	574564	435519512	27.5318	9 1178
759	576081	437245479	27.5500	9.1218
760	577600	438976000	27.5681	9.1258
761	579121	440711081	27.5862	9.1298
762	580644	442450728	27.6043	9.1338
763	582169	444194947	27.6225	9.1378
764	583696	445943744	27.6405	9 1418
765	585225	447697125	27.6586	9.1458
766	586756	449455096	27.6767	9.1498
767	588289	451217663	27.6948	9.1537
768	589824	452984832	27.7128	9.1577
769	591361	454756609	27 7308	9.1617
770	592900	456533000	27.7489	9.1657
771	594441	458314011	27.7669	9.1696
772	595984	460099648	27.7849	9.1736
773	597529	461889917	27.8029	9 1775
774	599076	463684824	27.8209	9.1815
775	600625	465484375	27.8388	9.1855
776	602176	467288576	27.8568	9.1894
777	603729	469097433	27.8747	9.1933
778	605284	470910952	27 8927	9.1973
779	606841	472729139	27.9106	9.2012

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
780	608400	474552000	27.9285	9.2052
781	609961	476379541	27.9464	9.2091
782	611524	478211768	27.9643	9.2130
783	613089	480048687	27.9821	9.2170
784	614656	481890304	28.0000	9 2209
785	616225	483736625	28.0179	9.2248
786	617796	485587656	28.0357	9.2287
787	619369	487443403	28.0535	9.2326
788	620944	489303872	28.0713	9.2365
789	622521	491169069	28.0891	9.2404
790	624100	493039000	28.1069	9.2443
791	625681	494913671	28.1247	9.2482
792	627624	496793088	28.1425	9.2521
793	628849	498677257	28.1603	9.2560
794	630436	500566184	28.1780	9.2599
795	632025	502459875	28.1957	9.2638
796	633616	504358336	28.2135	9.2677
797	635209	506261573	28.2312	9.2716
798	636804	508169592	28.2489	9.2754
799	638401	510082399	28.2666	9.2793
800	640000	512000000	28.2843	9.2832
801	641601	513922401	28.3019	9 2870
802	643204	515849608	28.3196	9 2909
803	644809	517781627	28.3373	9.2948
804	646416	519718464	28.3549	9.2986
805	648025	521660125	28.3725	9 3025
806	649636	523606616	28.3901	9.3063
807	651249	525557943	28.4077	9.3102
808	652864	527514112	28.4253	9.3140
809	654481	529475129	28.4429	9.3179
810	656100	531441000	28.4605	9.3217
811	657721	533411731	28.4781	9.3255
812	659344	535387328	28.4956	9.3294

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
813	660969	537367797	28.5132	9.3332
814	662596	539353144	28.5307	9.3370
815	664225	541343375	28 5482	9.3408
816	665856	543338496	28.5657	9.3447
817	667489	545338513	28.5832	9.3485
818	669124	547343432	28.6007	9.3523
819	670761	549353259	28.6182	9.3561
820	672400	551368000	28.6356	9.3599
821	674041	553387661	28.6531	9 3637
822	675684	555412248	28.6705	9.3675
823	677329	557441767	28.6880	9.3713
824	678976	559476224	28.7054	9.3751
825	680625	561515625	28.7228	9.3789
826	682276	563559976	28 7402	9.3827
827	683929	565609283	28.7576	9.3865
828	685584	567663552	28.7750	9.3902
829	687241	569722789	28 7924	9.3940
830	688900	571787000	28.8097	9.3978
831	690561	573856191	28.8271	9.4016
832	692224	575930368	28.8444	9.4053
833	693889	578009537	28.8617	9.4091
834	695556	580093704	28.8791	9.4129
835	697225	582182875	28 8964	9.4166
836	698896	584277056	28 9137	9.4204
837	700569	586376253	28.9310	9.4241
838	702244	588480472	28.9482	9.4279
839	703921	590589719	28.9655	9.4316
840	705600	592704000	28.9828	9.4354
841	707281	594823321	29.0000	9.4391
842	708964	596947688	29.0172	9.4429
843	710649	599077107	29.0345	9.4466
844	712336	601211584	29.0517	9.4503
845	714025	603351125	29.0689	9.4541

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
846	715716	605495736	29.0861	9.4578
847	717409	607645423	29.1033	9.4615
848	719104	609800192	29.1204	9.4652
849	720801	611960049	29.1376	9.4690
850	722500	614125000	29.1548	9.4727
851	724201	616295051	29.1719	9.4764
852	725904	618470208	29.1890	9.4801
853	727609	620650477	29.2062	9.4838
854	729316	622835864	29.2233	9.4875
855	731025	625026375	29.2404	9.4912
856	732736	627222016	29.2575	9.4949
857	734449	629422793	29.2746	9.4986
858	736164	631628712	29.2916	9.5023
859	737881	633839779	29.3087	9.5060
860	739600	636056000	29.3258	9.5097
861	741321	638277381	29.3428	9.5134
862	743044	640503928	29.3598	9.5171
863	744769	642735647	29.3769	9.5207
864	746496	644972544	29.3939	9.5244
865	748225	647214625	29.5109	9.5281
866	749956	649461896	29.4279	9.5317
867	751689	651714363	29.4449	9.5354
868	753424	653972032	29.4618	9.5391
869	755161	656234909	29.4788	9.5427
870	756900	658503000	29.4958	9.5464
871	758641	660776311	29.5127	9.5501
872	760384	663054848	29.5296	9.5537
873	762129	665338617	29.5466	9.5574
874	763876	667627624	29.5635	9.5610
875	765625	669921875	29.5804	9 5647
876	767376	672221376	29.5973	9.5683
877	769129	674526133	29.6142	9.5719
878	770884	676836152	29.6311	9.5756

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
879	772641	679151439	29.6479	9.5792
880	774400	681472000	29.6648	9.5828
881	776161	683797841	29.6816	9.5865
882	777924	686128968	29.6985	9.5901
883	779689	688465387	29.7153	9.5937
884	781456	690807104	29.7321	9.5973
885	783225	693154125	29.7489	9.6010
886	784996	695506456	29.7658	9.6046
887	786769	697864103	29.7825	9.6082
888	788544	700227072	29.7993	9.6118
889	790321	702595369	29.8161	9.6154
890	792100	704969000	29.8329	9.6190
891	793881	707347971	29.8496	9.6226
892	795664	707932288	29.8664	9 6262
893	797449	712121957	29.8831	9.6298
894	799236	714516984	29.8998	9.6334
895	801025	716917375	29.9166	9.6370
896	802816	719323136	29.9333	9.6406
897	804609	721734273	29.9500	9.6442
898	806404	724150792	29.9666	9.6477
899	808201	726572699	29 9833	9.6513
900	810000	729000000	30.0000	9.6549
901	811801	731432701	30 0167	9.6585
902	813604	733870808	30.0333	9.6620
903	815409	736314327	30.0500	9.6656
904	817216	738763264	30.0666	9.6692
905	819025	741217625	30.0832	9.6727
906	820836	743677416	30.0998	9.6763
907	822649	746142643	30.1164	9.6799
908	824464	748613312	30.1330	9.6834
909	826281	751089429	30.1496	9.6870
910	828100	753571000	30.1662	9.6905
911	829921	756058031	30.1828	9.6941

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
912	831744	758550825	30.1993	9.6976
913	833569	761048497	30.2159	9.7012
914	835396	763551944	30.2324	9.7047
915	837225	766060875	30.2490	9.7082
916	839056	768575296	30.2655	9 7118
917	840889	771095213	30.2820	9.7153
918	842724	773620632	30.2985	9.7188
919	844561	776151559	30.3150	9.7224
920	846400	778688000	30.3315	9.7259
921	848241	781229961	30 3480	9.7294
922	850084	783777448	30.3645	9.7329
923	851929	786330467	30.3809	9.7364
924	853776	788889024	30.3974	9.7400
925	855625	791453125	30.4138	9.7435
926	857476	794022776	30.4302	9.7470
927	859329	796597983	30.4467	9.7505
928	861184	799178752	30.4631	9.7540
929	863041	801765089	30.4795	9.7575
930	864900	804357000	30.4959	9.7610
931	866761	806954491	30.5123	9.7645
932	868624	809557568	30.5287	9.7680
933	870489	812166237	30.5450	9.7715
934	872356	814780504	30.5614	9.7750
935	874225	817400375	30.5778	9.7785
936	876096	820025856	30.5941	9.7829
937	877969	822656953	30.6105	9 7854
938	879844	825293672	30.6268	9.7889
939	881721	827936019	30.6431	9.7824
940	883600	830584000	30.6594	9.7959
941	885481	833237621	30.6757	9.7993
942	887364	835896888	30.6920	9.8028
943	889249	838561807	30.7083	9.8063
944	891136	841232384	30.7246	9.8097

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
945	893025	843908625	30.7409	9.8132
946	894916	846590536	30.7571	9.8167
947	896808	849278123	30.7734	9 8201
948	898704	851971392	30.7896	9.8236
949	900601	854670349	30.8058	9.8270
950	902500	857375000	30.8221	9.8305
951	904401	860085351	30.8383	9.8339
952	906304	862801408	30.8545	9.8374
953	908209	865523177	30.8707	9.8408
954	910116	868250664	30.8869	9.8443
955	912025	870983875	30.9031	9.8477
956	913936	873722816	30.9192	9.8511
957	915849	876467493	30.9354	9.8546
958	917764	879217912	30.9516	9.8580
959	919681	881974079	30.9677	9.8614
960	921600	884736000	30.9839	9.8648
961	923521	887503681	31.0000	9.8683
962	925444	890277128	31.0161	9.8717
963	927369	893056347	31.0322	9.8751
964	929296	895841344	31.0483	9.8785
965	931225	898632125	31.0644	9.8819
966	933156	901428696	31.0805	9.8854
967	935089	904231063	31.0966	9.8888
968	937024	907039232	31.1127	9.8922
969	938961	909853209	31.1288	9.8956
970	940900	912673000	31.1448	9.8990
971	942841	915498611	31.1609	9.9024
972	944784	918330048	31.1769	9.9058
973	946729	921167317	31.1929	9.9092
974	948676	924010424	31.2090	9.9126
975	950625	926859375	31.2250	9.9160
976	952576	929714176	31.2410	9.9194
977	954529	932574833	31.2570	9.9227

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
978	956484	935441352	31.2730	9.9261
979	958441	938313739	31.2890	9.9295
980	960400	941192000	31.3050	9.9329
981	962361	944076141	31.3209	9.9363
982	964324	946966168	31.3369	9.9396
983	966289	949862087	31.3528	9.9430
984	968256	952763904	31.3688	9.9464
985	970225	955671625	31.3847	9.9497
986	972196	958585256	31 4006	9.9531
987	974169	961504803	31.4166	9.9565
988	976144	964430272	31.4325	9.9598
989	978121	967361669	31.4484	9.9632
990	980100	970299000	31.4643	9.9666
991	982081	973242271	31.4802	9.9699
992	984064	976191488	31.4960	9.9733
993	986049	979146657	31.5119	9.9766
994	988036	982107784	31.5278	9.9800
995	990025	985074875	31.5436	0.9833
996	992016	988047936	31.5595	9.9866
997	994009	991026973	31.5753	9.9900
998	996004	994011992	31.5911	9.9933
999	998001	997002999	31.6070	9.9967
1000	1000000	1000000000	31.6228	10.0000
1001	1002001	1003003001	31.6386	10.0033
1002	1004004	1006012008	31.6544	10.0067
1003	1006009	1009027027	31.6702	10.0100
1004	1008016	1012048064	31.6860	10.0133
1005	1010025	1015075125	31.7017	10.0166
1006	1012036	1018108216	31.7175	10.0200
1007	1014049	1021147343	31.7333	10.0233
1008	1016064	1024192512	31 7490	10 0266
1009	1018081	1027243729	31.7648	10.0299
1010	1020100	1030301000	31.7805	10.0332

No.	Squares.	Cubes.	Sq. Roots.	C. Roots.
1011	1020121	1033364331	31.7962	10.0365
1012	1024144	1036433728	31.8119	10.0398
1013	1026169	1039509197	31.8277	10.0431
1014	1028196	1042590744	31.8434	10.0465
1015	1030225	1045678375	31.8591	10.0498
1016	1032256	1048772096	31.8748	10.0531
1017	1034289	1051871913	31.8904	10 0563
1018	1036324	1054977832	31 9061	10.0596
1019	1038361	1058089859	31.9218	10.0629
1020	1040400	1061208000	31.9374	10.0662
1021	1042441	1064332261	31.9531	10.0695
1022	1044484	1067462648	31.9687	10.0728
1023	1046529	1070599167	31.9844	10.0761
1024	1048576	1073741824	32.0000	10.0794
1025	1050625	1076890625	32.0156	10.0826
1026	1052676	1080045576	32.0312	10.0859
1027	1054729	1083206683	32.0468	10.0892
1028	1056784	1086373952	32.0624	10.0925
1029	1058841	1089547389	32.0780	10.0957
1030	1060900	1092727000	32.0936	10.0990
1031	1062961	1095912791	32.1092	10.1023
1032	1065024	1099104768	32.1248	10.1055
1033	1067089	1102302937	32.1403	10.1088
1034	1069156	1105507304	32.1559	10.1121
1035	1071225	1108717875	32.1714	10.1153
1036	1073296	1111934656	32.1870	10.1186
1037	1075369	1115157653	32.2025	10.1218
1038	1077444	1118386872	32.2180	10.1251
1039	1079521	1121622319	32.2335	10.1283
1040	1081600	1124864000	32.2490	10.1316
1041	1083681	1128111921	32.2645	10.1348
1042	1085764	1131366088	32.2800	10.1381

TABLE

OF

SINES AND TANGENTS.

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
0° 0′	0,0000	1,0000	0,0000	∞	90° 0′
10′	0,0029	1,0000	0,0029	343,77	50′
20′	0,0058	1,0000	0,0058	171,89	40′
30′	0,0087	1,0000	0,0087	114,59	30′
40′	0,0116	0,9999	0,0116	85,940	20′
50′	0,0145	0,9999	0,0145	68,750	10′
	29	1	29	11,460	
1° 0′	0,0175	0,9998	0,0175	57,290	89° 0′
10′	0,0204	0,9998	0,0204	49,104	50′
20′	0,0233	0,9997	0,0233	42,964	40′
30′	0,0262	0,9997	0,0262	38,188	30′
40′	0,0291	0,9996	0,0291	34,368	20′
50′	0,0320	0,9995	0,0320	31,242	10′
	29	1	29	2,606	
2° 0′	0,0349	0,9994	0,0349	28,636	88° 0′
10′	0,0378	0,9993	0,0378	26,432	50′
20′	0,0407	0,9992	0,0407	24,542	40′
30′	0,0436	0,9990	0,0437	22,904	30′
40′	0,0465	0,9989	0,0466	21,470	20′
50′	0,0494	0,9988	0,0495	20,206	10′
	29	1	29	1,125	

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
3° 0′	0,0523	0,9986	0,0524	19,081	87° 0′
10′	0,0552	0,9985	0,0553	18,075	50′
20′	0,0581	0,9983	0,0582	17,169	40′
30′	0,0610	0,9981	0,0612	16,350	30′
40′	0,0640	0,9980	0,0641	15,605	20′
50′	0,0669	0,9978	0,0670	14,924	10′
	29	2	29	623	
4° 0′	0,0698	0,9976	0,0699	14,301	86° 0′
10′	0,0727	0,9974	0,0729	13,727	50′
20′	0,0756	0,9971	0,0758	13,197	40′
30′	0,0785	0,9969	0,0787	12,706	30′
40′	0,0814	0,9967	0,0816	12,251	20′
50′	0,0843	0,9964	0,0846	11,826	10′
	29	2	29	396	
5° 0′	0,0872	0,9962	0,0875	11,430	85° 0′
10′	0 0901	0,9959	0,0904	11,059	50′
20′	0,0929	0,9957	0,0934	10,712	40′
30′	0,0958	0,9954	0,0963	10,385	30′
40′	0,0987	0,9951	0,0992	10,078	20′
50′	0,1016	0,9948	0,1022	9,7882	10′
	29	3	29	2738	
6° 0′	0,1045	0,9945	0,1051	9,5144	84° 0′
10′	0,1074	0,9942	0,1080	9,2553	50′
20′	0,1103	0,9939	0,1110	9,0098	40′
30′	0,1132	0,9936	0,1139	8,7769	30′
40′	0,1161	0,9932	0,1169	8,5555	20′
50′	0,1190	0,9929	0,1198	9,3450	10′
	29	4	29	2007	
7° 0′	0,1219	0,9925	0,1228	8,1443	83° 0′
10′	0,1248	0,9922	0,1257	7,9530	50′
20′	0,1276	0,9918	0,1287	7,7704	40′
30′	0,1305	0,9914	0,1317	7,5958	30′
40′	0,1334	0,9911	0,1346	7,4287	20′

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
50′	0,1363	0,9907	0,1376	7,2687	10′
	29	4	29	1533	
8° 0′	0,1392	0,9903	0,1405	7,1154	82° 0′
10′	0,1421	0,9899	0,1435	6,9682	50′
20′	0,1449	0,9894	0,1465	6,8269	40′
30′	0,1478	0,9890	0,1495	6,6912	30′
40′	0,1507	0,9896	0,1524	6,5606	20′
50′	0,1536	0,9881	0,1554	6,4348	10′
	28	4	30	1210	
9° 0′	0,1564	0,9877	0,1584	6,3138	81° 0′
10′	0,1593	0,9872	0,1614	6,1970	50′
20′	0,1622	0,9868	0,1644	6,0844	40′
30′	0,1650	0,9863	0,1673	5,9758	30′
40′	0,1679	0,9858	0,1703	5,8708	20′
50′	0,1708	0,9853	0,1733	5,7694	10′
	28	5	30	981	
10° 0′	0,1736	0,9848	0,1763	5,6713	80° 0′
10′	0,1765	0,9843	0,1793	5,5764	50′
20′	0,1794	0,9838	0,1823	5,4845	40′
30′	0,1822	0,9833	0,1853	5,3955	30′
40′	0,1851	0,9827	0,1883	5,3093	20′
50′	0,1880	0,9922	0,1914	5,2257	10′
	28	6	30	811	
11° 0′	0,1908	0,9816	0,1944	5,1446	79° 0′
10′	0,1937	0,9811	0,1974	5,0658	50′
20′	0,1965	0,9805	0,2004	4,9894	40′
30′	0,1994	0,9799	0,2035	4,9152	30′
40′	0,2022	0,9793	0,2065	4,8430	20′
50′	0,2051	0,9787	0,2095	4,7729	10′
	28	6	31	683	
12° 0′	0,2079	0,9781	0,2126	4,7046	78° 0′
10′	0,2108	0,9775	0,2156	4,6382	50′
20′	0,2136	0,9769	0,2186	4,5736	40′

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
30′	0,2164	0,9763	0,2217	4,5107	30′
40′	0,2193	0,9757	0,2247	4,4494	20′
50′	0,2221	0,9750	0,2278	4,3897	10′
	28	6	31	582	
13° 0′	0,2250	0,9714	0,2309	4,3315	77° 0′
10′	0,2278	0,9737	0,2339	4,2747	50′
20′	0,2306	0,9730	0,2370	4,2193	40′
30′	0,2334	0,9724	0,2401	4,1653	30′
40′	0,2363	0,9717	0,2432	4,1126	20′
50′	0,2391	0,9710	0,2462	4,0611	10′
	28	7	31	503	
14° 0′	0,2419	0,9703	0,2493	4,0108	76° 0′
10′	0,2447	0,9696	0,2524	3,9617	50′
20′	0,2476	0,9689	0,2555	3,9136	40′
30′	0,2504	0,9681	0,2586	3,8667	30′
40′	0,2532	0,9674	0,2617	3,8208	20′
50′	0,2560	0,9667	0,2648	3,7760	10′
	28	7	31	439	
15° 0′	0,2588	0,9659	0,2679	3,7321	75° 0′
10′	0,2616	0,9652	0,2711	3,6891	50′
20′	0,2644	0,9644	0,2742	3,6470	40′
30′	0,2672	0,9636	0,2773	3,6059	30′
40′	0,2700	0,9628	0,2805	3,5656	20′
50′	0,2728	0,9621	0,2836	3,5261	10′
	28	8	31	387	
16° 0′	0,2756	0,9613	0,2867	3,4874	74° 0′
10′	0,2784	0,9605	0,2899	3,4495	50′
20′	0,2812	0,9596	0,2931	3,4124	40′
30′	0,2840	0,9588	0,2962	3,3759	30′
40′	0,2868	0,9580	0,2994	3,3402	20′
50′	0,2896	0,9572	0,3026	3,3052	10′
	28	9	31	343	
17° 0′	0,2924	0,9563	0,3057	3,2709	73° 0′

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
10′	0,2952	0,9555	0,3089	33,271	50′
20′	0,2979	0,9546	0,3121	3,2041	40′
30′	0,3007	0,9537	0,3153	3,1716	30′
40′	0 3035	0,9528	0,3185	3,1397	20′
50′	0,3062	0,9520	0,3217	3,1084	10′
	28	9	32	307	
18° 0′	0,3090	0,9511	0,3249	30,777	72° 0′
10′	0,3118	0,9502	0,3281	3,0475	50′
20′	0,3145	0,9492	0,3314	3,0178	40′
30′	0,3173	0,9483	0,3346	2,9887	30′
40′	0,3201	0,9474	0,3378	2,9600	20′
50′	0,3228	0,9465	0,3411	2,9319	10′
	27	10	32	277	
19° 0′	0,3256	0,9455	0,3443	2,9042	71° 0′
10′	0,3283	0,9446	0,3476	2,8770	50′
20′	0,3311	0,9436	0,3508	2,8502	40′
30′	0,3338	0,9426	0,3541	2,8239	30′
40′	0,3365	0,9417	0,3574	2,7980	20′
50′	0,3393	0,9407	0,3607	2,7725	10′
	27	10	33	250	
20° 0′	0,3420	0,9397	0,3640	2,7475	70° 0′
10′	0,3448	0,9387	0,3673	2,7228	50′
20′	0,3475	0,9377	0,3706	2,6985	40′
30′	0,3502	0,9367	0,3739	2,6746	30′
40′	0,3529	0,9356	0,3772	2,6511	20′
50′	0,3557	0,9346	0,3805	2,6279	10′
	27	10	34	228	
21° 0′	0,3584	0,9336	0,3839	2,6051	69° 0′
10′	0,3611	0,9325	0,3872	2,5826	50′
20′	0,3638	0,9315	0,3906	2,5605	40′
30′	0,3665	0,9304	0,3939	2,5386	30′
40′	0,3692	0,9293	0,3973	2,5172	20′
50′	0,3719	0,9283	0,4006	2,4960	10′
	27	11	34	209	

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
22° 0′	0,3746	0,9272	0,4040	2,4751	68° 0′
10′	0,3773	0,9261	0,4074	2,4545	50′
20′	0,3800	0,9250	0,4108	2,4342	40′
30′	0,3827	0,9239	0,4142	2,4142	30′
40′	0,3854	0,9228	0,4176	2,3945	20′
50′	0,3881	0,9216	0,4210	2,3750	10′
	27	11	35	191	
23° 0′	0,3907	0,9205	0,4245	2,3559	67° 0′
10′	0,3934	0,9194	0,4279	2,3369	50′
20′	0,3961	0,9182	0,4314	2,3183	40′
30′	0,3987	0,9171	0,4348	2,2998	30′
40′	0,4014	0,9159	0,4383	2,2817	20′
50′	0,4041	0,9147	0,4417	2,2637	10′
	26	12	35	177	
24° 0′	0,4067	0,9135	0,4452	2,2460	66° 0′
10′	0.4094	0,9124	0,4487	2,2286	50′
20′	0,4120	0,9112	0,4522	2,2113	40′
30′	0,4147	0,9100	0,4557	2,1943	30′
40′	0,4173	0,9088	0,4592	2,1775	20′
50′	0,4200	0,9075	0,4628	2,1609	10′
	26	12	35	164	
25° 0′	0,4226	0,9063	0,4663	2,1445	65° 0′
10′	0,4253	0,9051	0,4699	2,1283	50′
20′	0,4279	0,9038	0,4734	2,1123	40′
30′	0,4305	0,9026	0,4770	2,0965	30′
40′	0,4331	0,9013	0,4806	2,0809	20′
50′	0,4358	0,9001	0,4841	2,0655	10′
	26	13	36	152	
26° 0′	0,4384	0,8988	0,4877	2,0503	64° 0′
10′	0,4410	0,8975	0,4913	2,0353	50′
20′	0,4436	0,8962	0,4950	2,0204	40′
30′	0,4462	0,8949	0,4986	2,0057	30′
40′	0,4488	0,8936	0,5022	1,9912	20′

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
50′	0,4514	0,8923	0,5059	1,9768	10′
	26	13	36	142	
27° 0′	0,4540	0,8910	0,5095	1,9626	63° 0′
10′	0,4566	0,8897	0,5132	1,9486	50′
20′	0,4592	0,8884	0,5169	1,9347	40′
30′	0,4617	0,8870	0,5206	1,9210	30′
40′	0,4643	0,8857	0,5243	1,9074	20′
50′	0,4669	0,8843	0,5280	1,8940	10′
	26	14	37	133	
28° 0′	0,4695	0,8829	0,5317	1,8807	62° 0′
10′	0,4720	0,8816	0,5354	1,8676	50′
20′	0,4746	0,8802	0,5392	1,8546	40′
30′	0,4772	0,8788	0,5430	1,8418	30′
40′	0,4797	0,8774	0,5467	1,8291	20′
50′	0,4823	0,8760	0,5505	1,8165	10′
	25	14	38	125	
29° 0′	0,4848	0,8746	0,5543	1,8040	61° 0′
10′	0,4874	0,8732	0,5581	1,7917	50′
20′	0,4899	0,8718	0,5619	1,7796	40′
30′	0,4924	0,8704	0,5658	1,7675	30′
40′	0,4950	0,8689	0,5696	1,7556	20′
50′	0,4975	0,8675	0,5735	1,7437	10′
	25	15	39	116	
30° 0′	0,5000	0,8660	0,5774	1,7321	60° 0′
10′	0,5025	0,8646	0,5812	1,7205	50′
20′	0,5050	0,8631	0,5851	1,7090	40′
30′	0,5075	0,8616	0,5890	1,6977	30′
40′	0,5100	0,8601	0,5930	1,6864	20′
50′	0,5125	0,8587	0,5969	1,6753	10′
	25	15	40	110	
31° 0′	0,5150	0,8572	0,6009	1,6643	59° 0′
10′	0,5175	0,8557	0,6048	1,6534	50′
20′	0,5200	0,8542	0,6088	1,6426	40′

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
30′	0,5225	0,8526	0,6128	1,6319	30′
40′	0,5250	0,8511	0,6168	1,6212	20′
50′	0,5275	0,8496	0,6208	1,6107	10′
	25	16	41	104	
32° 0′	0,5299	0,8480	0,6249	1,6003	58° 0′
10′	0,5324	0,8465	0,6289	1,5900	50′
20′	0,5348	0,8450	0,6330	1,5798	40′
30′	0,5373	0,8434	0,6371	1,5697	30′
40′	0,5398	0,8418	0,6412	1,5597	20′
50′	0,5422	0,8403	0,6453	1,5497	10′
	24	16	41	98	
33° 0′	0,5446	0,8387	0,6494	1,5399	57° 0′
10′	0,5471	0,8371	0,6536	1,5301	50′
20′	0,5495	0,8355	0,6577	1,5204	40′
30′	0,5519	0,8339	0,6619	1,5108	30′
40′	0,5544	0,3323	0,6661	1,5013	20′
50′	0,5568	0,3307	0,6703	1,4919	10′
	24	17	42	93	
34° 0′	0,5592	0,8290	0,6745	1,4826	56° 0′
10′	0,5616	0,8274	0,6787	1,4733	50′
20′	0,5640	0,8258	0,6830	1,4641	40′
30′	0,5664	0,8241	0,6873	1,4550	30′
40′	0,5688	0,8225	0,6916	1,4460	20′
50′	0,5712	0,8208	0,6959	1,4370	10′
	24	17	43	89	
35° 0′	0,5736	0,8192	0,7002	1,4281	55° 0′
10′	0,5760	0,8175	0,7046	1,4193	50′
20′	0,5783	0,8158	0,7089	1,4106	40′
30′	0,5807	0,8141	0,7133	1,4019	30′
40′	0,5831	0,8124	0,7177	1,3934	20′
50′	0,5854	0,8107	0,7221	1,3848	10′
	24	17	44	84	
36° 0′	0,5878	0,8090	0,7265	1,3764	54° 0′

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
10′	0,5901	0,8073	0,7310	1,3680	50′
20′	0,5925	0,8056	0,7355	1,3597	40′
30′	0,5948	0,8039	0,7400	1,3514	30′
40′	0 5972	0,8021	0,7445	1,3432	20′
50′	0,5995	0,8004	0,7490	1,3351	10′
	23	18	46	81	
37° 0′	0,6018	0,7986	0,7536	1,3270	53° 0′
10′	0,6041	0,7969	0,7581	1,3190	50′
20′	0,6065	0,7951	0,7627	1,3111	40′
30′	0,6088	0,7934	0,7673	1,3032	30′
40′	0,6111	0,7916	0,7720	1,2954	20′
50′	0,6134	0,7898	0,7766	1,2876	10′
	23	18	47	77	
38° 0′	0,6157	0,7880	0,7813	1,2799	52° 0′
10′	0,6180	0,7862	0,7860	1,2723	50′
20′	0,6202	0,7844	0,7907	1,2647	40′
30′	0,6225	0,7826	0,7954	1,2572	30′
40′	0,6248	0,7808	0,8002	1,2497	20′
50′	0,6271	0,7790	0,8050	1,2423	10′
	23	19	48	74	
39° 0′	0,6293	0,7771	0,8098	1,2349	51° 0′
10′	0,6316	0,7753	0,8146	1,2276	50′
20′	0,6338	0,7735	0,8195	1,2203	40′
30′	0,6361	0,7716	0,8243	1,2131	30′
40′	0,6383	0,7698	0,8292	1,2059	20′
50′	0,6406	0,7679	0,8342	1,1988	10′
	22	19	49	70	
40° 0′	0,6428	0,7660	0,8391	1,1918	50° 0′
10′	0,6450	0,7642	0,8441	1,1847	50′
20′	0,6472	0,7623	0,8491	1,1778	40′
30′	0,6494	0,7604	0,8541	1,1708	30′
40′	0,6517	0,7585	0,8591	1,1640	20′
50′	0,6539	0,7566	0,8642	1,1571	10′
	22	19	51	67	

Deg.	Sin.	Cos.	Tan.	Cotan.	Deg.
41° 0′	0,6561	0,7547	0,8693	1,1504	49° 0′
10′	0,6583	0,7528	0,8744	1,1436	50′
20′	0,6604	0,7509	0.8796	1,1369	40′
30′	0,6626	0,7490	0,8847	1,1303	30′
40′	0,6648	0,7470	0,8899	1,1237	20′
50′	0,6670	0,7451	0,8952	1,1171	10′
	21	20	52	65	
42° 0′	0,6691	0,7431	0,9004	1,1106	48° 0′
10′	0,6713	0,7412	0,9057	1,1041	50′
20′	0,6734	0,7392	0,9110	1,0977	40′
30′	0,6756	0,7373	0,9163	1,0913	30′
40′	0,6777	0,7353	0,9217	1,0850	20′
50′	0,6799	0,7333	0,9271	1,0786	10′
	21	20	54	62	
43° 0′	0,6820	0,7314	0,9325	1,0724	47° 0′
10′	0,6841	0,7294	0,9380	1,0661	50′
20′	0,6862	0,7274	0,9435	1,0599	40′
30′	0,6884	0,7254	0,9490	1,0538	30′
40′	0,6905	0,7234	0,9545	1,0477	20′
50′	0,6926	0,7214	0,9601	1,0416	10′
	21	21	56	61	
44° 0′	0,6947	0,7193	0,9657	1,0355	46° 0′
10′	0,6967	0,7173	0,9713	1,0295	50′
20′	0,6988	0,7153	0,9770	1,0235	40′
30′	0,7009	0,7133	0,9827	1,0176	30′
40′	0,7030	0,7112	0,9884	1,0117	20′
50′	0,7050	0,7092	0,9942	1,0058	10′
	21	21	58	58	
45° 0′	0,7071	0,7071	1,0000	1,0000	45° 0

TABLE

OF

CIRCUMFERENCES AND AREAS OF CIRCLES.

Diam.	Circum.	Area.	Diam.	Circum.	Area.
1,0	3,142	0,7854	3,1	9,739	7,5477
1,1	3,456	0,9503	3,2	10,053	8,0425
1,2	3,770	1,1310	3,3	10,367	8,5530
1,3	4,084	1,3273	3,4	10,681	9,0792
1,4	4,398	1,5394	3,5	10,996	9,6211
1,5	4,712	1,7672	3,6	11,310	10,179
1,6	5,027	2,0106	3,7	11,624	10,752
1,7	5,341	2,2698	3,8	11.938	11,341
1,8	5,655	2,5447	3,9	12,252	11,946
1,9	5,969	2,8353	4,0	12,566	12,566
2,0	6,283	3,1416	4,1	12,881	13 203
2,1	6,597	3,4636	4,2	13,195	13,854
2,2	6,912	3,8013	4,3	13,509	14,522
2,3	7,226	4,1548	4,4	13,823	15,205
2,4	7,540	4,5239	4,5	14,137	15,904
2,5	7,854	4,9087	4,6	14,451	16,619
2,6	8,168	5,3093	4,7	14,765	17,349
2,7	8,482	5,7256	4,8	15,080	18,096
2,8	8,797	6,1575	4,9	15,394	18,857
2,9	9,111	6,6052	5,0	15,708	19,635
3,0	9,425	7,0686	5,1	16,022	20,428

Diam.	Circum.	Area.	Diam.	Circum.	Area.
5,2	16,336	21,237	8,5	26,704	56,745
5,3	16,650	22,062	8,6	27,018	58,088
5,4	16,965	22,902	8,7	27,332	59,447
5,5	17,279	23,758	8,8	27,646	60,821
5,6	17,593	24,630	8,9	27,960	62,211
5,7	17,907	25,518	9,0	28,274	63,617
5,8	18,221	26,421	9,1	28,588	65,039
5,9	18,535	27,340	9,2	28,903	66,476
6,0	18,850	28,274	9,3	29,217	67,929
6,1	19,164	29 225	9,4	29,531	69 398
6,2	19,478	30,191	9,5	29,845	70,882
6,3	19,792	31,173	9,6	30,159	72,382
6,4	20,106	32,170	9,7	30,473	73,898
6,5	20,420	33,183	9,8	30.788	75,430
6,6	20,735	34,212	9,9	31,102	76,977
6,7	21,049	35,257	10,0	31,416	78,540
6,8	21,363	36,317	10,1	31,730	80,119
6,9	21,677	37,393	10,2	32,044	81,713
7,0	21,991	38,485	10,3	32,358	83,323
7,1	22,305	39,592	10,4	32,673	84,949
7,2	22,619	40,715	10,5	32,987	86,590
7,3	22,934	41,854	10,6	33,301	88,247
7,4	22,248	43,008	10,7	33,615	89,920
7,5	23,562	44,179	10,8	33,929	91,609
7,6	23,876	45,365	10,9	34,243	93,313
7,7	24,190	46,566	11,0	34,558	95,033
7,8	24,504	47,784	11,1	34,872	96,769
7,9	24,819	49,017	11,2	35,186	98,520
8,0	25,133	50,266	11,3	35,500	100,29
8,1	25,447	51,530	11,4	35,814	102,07
8,2	25,761	52,810	11,5	36,128	103,87
8,3	26,075	54,106	11,6	36,442	105,68
8,4	26,389	55,418	11,7	36,757	107,51

Diam.	Circum.	Area.	Diam.	Circum.	Area.
11,8	37,071	109,36	15,1	47,438	179,08
11,9	37,385	111,22	15,2	47,752	181,46
12,0	37,699	113,10	15,3	48,066	183,85
12,1	38,013	114,99	15,4	48,381	186,27
12,2	38,327	116,90	15.5	48,695	188,69
12,3	38,642	118,82	15,6	49,009	191,13
12,4	38,956	120,76	15,7	49,323	193,59
12,5	39,270	122,72	15,8	49,637	196,07
12,6	39,584	124,69	15,9	49,951	198,56
12,7	39,898	126,68	16,0	50,265	201,06
12,8	40,212	128,68	16,1	50,580	203,58
12,9	40,527	130,70	16,2	50,894	206,12
13,0	40,841	132,73	16,3	51,208	208,67
13,1	41,155	134,78	16,4	51,522	211,24
13,2	41,469	136,85	16,5	51,836	213,83
13,3	41,783	138,93	16,6	52,150	216,42
13,4	42,097	141,03	16,7	52,465	219,04
13,5	42,412	143,14	16,8	52,779	221,67
13,6	42,726	145,27	16,9	53,093	224,32
13,7	43,040	147,41	17,0	53,407	226,98
13,8	43,354	149,57	17,1	53,721	229,66
13,9	43,668	151,75	17,2	54,035	232,35
14,0	43,982	153,94	17,3	54,350	235,06
14,1	44,296	156,15	17,4	54,664	237,79
14,2	44,611	158,37	17,5	54,978	240,53
14,3	44,925	160,61	17,6	55,292	243,29
14,4	45,239	162,86	17,7	55,606	246,06
14,5	45,553	165,13	17,8	55,920	248,85
14,6	45,867	167,42	17,9	56,235	251,65
14,7	46,181	169,72	18,0	56,549	254,47
14,8	46,496	172,03	18,1	56,863	257,30
14,9	46,810	174,37	18,2	57,177	260,16
15,0	47,124	176,72	18,3	57,491	263,02

CIRCUMFERENCES AND AREAS OF CIRCLES.

Diam.	Circum.	Area.	Diam.	Circum.	Area.
18,4	57,805	265,90	21,7	68,173	369,84
18,5	58,119	268,80	21,8	68,487	373,25
18,6	58,434	271,72	21,9	68,801	376,69
18,7	58,748	274,65	22,0	69,115	380,13
18,8	59,062	277,59	22,1	69,429	383,60
18,9	59,376	280,55	22,2	69,743	387,08
19,0	59,690	283,53	22,3	70,058	390,57
19,1	60,004	286,52	22,4	70,372	394,08
19,2	60,319	289,53	22,5	70,686	397,61
19,3	60,633	292,55	22,6	71,000	401,15
19,4	60,947	295,59	22,7	71,314	404,71
19,5	61,261	298,65	22,8	71,628	408,28
19,6	61,575	301,72	22,9	71,942	411,87
19,7	61,889	304,81	23,0	72,257	415,48
19,8	62,204	307,91	23,1	72,571	419,10
19,9	62,518	311,03	23,2	72,885	422,73
20,0	62,832	314,16	23,3	73,199	426,39
20,1	63,146	317,31	23,4	73,513	430,05
20,2	63,460	320,47	23,5	73,827	433,74
20,3	63,774	323,66	23,6	74,142	437,44
20,4	64,088	326,85	23,7	74,456	441,15
20,5	64,403	330,06	23,8	74,770	444,88
20,6	64,717	333,29	23,9	75,084	448,63
20,7	65,031	336,54	24,0	75,398	452,39
20,8	65,345	339,80	24,1	75,712	456,17
20,9	65,659	343,07	24,2	76,027	459,96
21,0	65,973	346,36	24,3	76,341	463,77
21,1	66,288	349,67	24,4	76,655	467,60
21,2	66,602	352,99	24,5	76,969	471,44
21,3	66,916	356,33	24,6	77,283	475,29
21,4	67,230	359,68	24,7	77,597	479,16
21,5	67,544	363,05	24,8	77,911	483.05
21,6	67,858	366,44	24,9	78,226	486,96

Diam.	Circum.	Area.	Diam.	Circum.	Area.
21,7	68,173	369,84	25,0	78,540	490,87
21,8	68,487	373,25	25,1	78,854	494,81
21,9	68,801	376,69	25,2	79,168	498,76
22,0	69,115	380,13	25,3	79,482	502,73
22,1	69,429	383,60	25,4	79,796	506,71
22,2	69,743	387,08	25,5	80,111	510,71
22,3	70,058	390,57	25,6	80,425	514,72
22,4	70,372	394,08	25,7	80,739	518,75
22,5	70,686	397,61	25,8	81,053	522,79
22,6	71,000	401,15	25,9	81,367	526,85
22,7	71,314	404,71	26,0	81,681	530,93
22,8	71,628	408,28	26.1	81,996	535,02
22,9	71,942	411,87	26,2	82,310	539,13
23,0	72,257	415,48	26,3	82,624	543,25
23,1	72,571	419,10	26,4	82,938	547,39
23,2	72,885	422,73	26,5	83,252	551,55
23,3	73,199	426,39	26,6	83,566	555,72
23,4	73,513	430,05	26,7	83,881	559,90
23,5	73,827	433,74	26,8	84,195	564,10
23,6	74,142	437,44	26,9	84,509	568,32
23,7	74,456	441,15	27,0	84,823	572,56
23,8	74,770	444,88	27,1	85,137	576,80
23,9	75,084	448,63	27,2	85,451	581,07
24,0	75,398	452,39	27,3	85,765	585,35
24,1	75,712	456,17	27,4	86,080	589,65
24,2	76,027	459,96	27,5	86,394	593,96
24,3	76,341	463,77	27,6	86,708	598,29
24,4	76,655	467,60	27,7	87,022	602,63
24,5	76,969	471,44	27,8	87,336	606,99
24,6	77,283	475,29	27,9	87,650	611,36
24,7	77,597	479,16	28,0	87,965	615,75
24,8	77,911	483,05	28,1	88,279	620.16
24,9	78,226	486,96	28,2	88,593	624,58

Diam.	Circum.	Area.	Diam.	Circum.	Area.
28,3	88,907	629,02	31,6	99,274	784,27
28,4	89,221	633,47	31,7	99,588	789,24
28 5	89,535	637,94	31,8	99,903	794,23
28,6	89,850	642,42	31,9	100,22	799,23
28,7	90,164	646,93	32,0	100,53	804,25
28,8	90,478	651,44	32,1	100,85	809,28
28,9	90,792	655,97	32,2	101,16	814.33
29,0	91,106	660,52	32,3	101,47	819,40
29,1	91,420	665,08	32,4	101,79	824,48
29,2	91,735	669,66	32,5	102,10	829,58
29.3	92,049	674,26	32,6	102,42	834,69
29,4	92,363	678,87	32,7	102,73	839,82
29,5	92,677	683 49	32,8	103,04	844,96
29,6	92,991	688,13	32,9	103,36	850,12
29,7	93,305	692,79	33,0	103,67	855,30
29,8	93.619	697,47	33,1	103,99	860,49
29,9	93,934	702,15	33,2	104,30	865,70
30.0	94,248	706,86	33,3	104,62	870,92
30,1	94,562	711,58	33,4	104,93	876,16
30,2	94,876	716,32	33,5	105,24	881,41
30,3	95,190	721,07	33,6	105,56	886,68
30,4	95.504	725,83	33,7	105,87	891,97
30,5	95,819	730,62	33,8	106,19	897,27
30,6	96,133	735,42	33,9	106,50	902,59
30,7	96,447	740,23	34,0	106,81	907,92
30,8	96,761	745,06	34,1	107,13	913,27
30,9	97,075	749,91	34,2	107,44	918,63
31,0	97,389	754,77	34,3	107.76	924,01
31,1	97,704	759,65	34,4	108,07	929,41
31,2	98.018	764,54	34,5	108,38	934,82
31,3	98,332	769,45	34,6	108,70	940,25
31,4	98,646	774,37	34,7	109,01	945,69
31,5	98,960	779,31	34,8	109,33	951,15

Diam.	Circum.	Area.	Diam.	Circum.	Area.
34,9	109,64	956,62	38.3	120,32	1152,09
35,0	109,96	962,11	38,4	120,64	1158,12
35,1	119,27	967,62	38,5	120,95	1164,16
35,2	110,58	973,14	38,6	121,27	1170,21
35,3	110,90	978,68	38,7	121,58	1176,28
35,4	111,21	984,23	38,8	121,89	1182,37
35,5	111,53	989,80	38,9	122,21	1188,47
35,6	111,84	995,38	39,0	122,52	1194,59
35,7	112,15	1000,98	39.1	122,84	1200,72
35,8	112,47	1006,60	39,2	123,15	1206,87
35,9	112,78	1012,23	39,3	123,46	1213,04
36,0	113,10	1017,88	39,4	123,78	1219,22
36,1	113,41	1023,54	39.5	124,09	1225,42
36,2	113,73	1029,22	39,6	124,41	1231,63
36,3	114,04	1034,91	39,7	124,72	1237,86
36,4	114,35	1040,62	39,8	125 04	1244,10
36,5	114,67	1046,35	39,9	125,35	1250,36
36,6	114,98	1052,09	40,0	125,66	1256,64
36,7	115,30	1057,84	40,1	125,98	1262,93
36,8	115,61	1063,62	40,2	126,29	1269,23
36,9	115,92	1069.41	40,3	126.61	1275,56
37,0	116,24	1075,21	40,4	126,92	1281,90
37,1	116,55	1081,03	40,5	127,23	1288,25
37,2	116,87	1086,87	40,6	127,55	1294,62
37,3	117,18	1092,72	40,7	127,86	1301,00
37,4	117,50	1098,58	40,8	128,18	1307,41
37,5	117,81	1104,47	40,9	128,49	1313,82
37,6	118,12	1110,36	41,0	128,81	1320,25
37,7	118,44	1116,28	41,1	129,12	1326,70
37,8	118,75	1122,21	41,2	129,43	1333,17
37,9	119,07	1128,15	41,3	129,75	1339,65
38,0	119,38	1134,11	41,4	130,06	1346.14
38,1	119,69	1140,09	41.5	130,38	1352,65
38,2	120,01	1146,08	41,6	130,69	1359,18

Diam.	Circum.	Area.	Diam.	Circum.	Area.
41,7	131,00	1365,72	45,1	141,69	1597,51
41,8	131,32	1372,28	45,2	142,00	1604,60
41,9	131,63	1378,85	45,3	142,31	1611 71
42,0	131,95	1385,44	45,4	142,63	1618,83
42,1	132,26	1392,05	45,5	142,94	1625,97
42,2	132,58	1398,67	45,6	143,26	1633,13
42,3	132,89	1405,31	45,7	143,57	1640,30
42,4	133,20	1411,96	45,8	143,88	1647,48
42,5	133.52	1418,63	45,9	144,20	1654,68
42,6	133,83	1425,31	46,0	144,51	1661,90
42,7	134,15	1432,01	46,1	144,83	1669,14
42,8	134,46	1438,72	46,2	145,14	1676,39
42,9	134,77	1445,45	46,3	145,46	1683,65
43,0	135,09	1452,20	46,4	145,77	1690.93
43,1	135,40	1458,96	46,5	146,08	1698,23
43,2	135.72	1465,74	46,6	146,40	1705,54
43,3	136,03	1472,54	46,7	146,71	1712,87
43,4	136,35	1479.34	46,8	147 03	1720,21
43,5	136,66	1486,17	46,9	147,34	1727,57
43,6	136,97	1493,01	47,0	147,65	1734,94
43,7	137,29	1499,87	47,1	147,97	1742,34
43,8	137,60	1506,74	47,2	148,28	1749,74
43,9	137,92	1513,63	47,3	148,60	1757.16
44,0	138,23	1520,53	47,4	148,91	1764,60
44,1	138,54	1527,45	47.5	149,23	1772,05
44,2	138,86	1534,39	47,6	149,54	1779,52
44,3	139,17	1541,34	47,7	149,85	1787,01
44,4	139,49	1548.30	47,8	150,17	1794,51
44,5	139,80	1555,28	47,9	150,48	1802,03
44,6	140,12	1562,28	48,0	150,80	1809,56
44,8	140,43	1569,30	48,1	151,11	1817,11
44.7	140,74	1576,33	48,2	151,42	1824,67
44,9	141,06	1583,37	48,3	151,74	1832,25
45,0	141,37	1590,43	48,4	152,05	1839,84

CIRCUMFERENCES AND AREAS OF CIRCLES.

Diam.	Circum.	Area.	Diam.	Circum.	Area.
48,5	152,37	1847,45	68,0	213,63	3631,69
48,6	152.68	1855,08	69,0	216,77	3739,29
48,7	153,00	1862,72	70,0	219,91	3848,46
48,8	153,31	1870,38	71,0	223,05	3959,20
48,9	153,62	1878,05	72,0	226,19	4071,51
49,0	153,94	1885,74	73,0	229,33	4185,39
49,1	154,25	1893 45	74,0	232,47	4300,85
49,2	154.57	1901,17	75,0	235,62	4417,87
49,3	154,88	1908,90	76,0	238,76	4536,47
49,4	155,19	1916,65	77,0	241,90	4656,63
49,5	155,51	1924,42	78,0	245,04	4778,37
49,6	155,82	1932,21	79,0	248,18	4901,68
49,7	156,14	1940,00	80,0	251,32	5026,56
49,8	156,45	1947,82	81,0	254.47	5153,01
49.9	156,77	1955,65	82,0	257,61	5281,03
50,0	157,08	1963,50	83,0	260,75	5410,62
51,0	160,22	2042,82	84,0	263,89	4541,78
52,0	163,36	2123,72	85,0	267,03	5674,50
53,0	166,50	2206,19	86,0	270,17	5808,81
54,0	169,64	2290,22	87,0	273,32	5944,69
55,0	172,78	2375,83	88,0	276,46	6082,13
56,0	175,93	2463,01	89,0	279,60	6221,13
57,0	179,07	2551,76	90,0	282,74	6361,74
58,0	182,21	2642,08	91,0	285,88	6503,89
59,0	185,35	2733,97	92,0	289,02	6647,62
60,0	188,49	2827,44	93,0	292,17	6792,92
61,0	191,63	2922,47	94,0	295,31	6939,78
62,0	194,77	3019,07	95,0	298,45	7088,23
63,0	197,92	3117,25	96,0	301,59	7238,24
64,0	201,06	3216,99	97,0	304,73	7389,83
65,0	204,20	3318,31	98,0	307,87	7542,98
66,0	207,34	3421,20	99,0	311,02	7697.68
67,0	210,48	3525,66	100,0	314,16	7854,00

TABLE

OF THE

AREAS OF THE ZONES OF A CIRCLE.

Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.
.001	.00100	.022	.02199	.043	.04294
.002	.00200	.023	.02299	.044	.04394
.003	.00300	.024	.02399	.045	.04494
.004	.00400	.025	.02499	.046	.04593
.005	.00500	.026	.02598	.047	.04693
.006	.00600	.027	.02698	.048	.04792
.007	.00700	.028	.02798	.049	.04892
.008	.00800	.029	.02898	.050	.04991
.009	.00900	.030	.02998	.051	.05091
.010	.01000	.031	.03098	.052	.05190
.011	.01100	.032	.03197	.053	.05290
.012	.01199	.033	.03297	.054	.05389
.013	.01299	.034	.03397	.055	.05489
.014	.01399	.035	.03497	.056	.05588
.015	.01499	.036	.03596	.057	.05687
.016	.01599	.037	.03696	.058	.05787
.017	.01699	.038	.03796	.059	.05886
.018	.01799	.039	.03896	.060	.05985
.019	.01899	.040	.02995	.061	.06084
.020	.01999	.041	.04095	.062	.06184
.021	.02099	.042	.04195	.063	.06283

AREAS OF THE ZONES OF A CIRCLE.

Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.
.064	.06382	.097	.09638	.130	.12852
.065	.06481	.098	.09736	.131	.12948
.066	.06580	.099	.09835	.132	.13045
.067	.06679	.100	.09933	.133	.13141
.068	.06779	.101	.10030	.134	.13237
.069	.06878	.102	.10128	.135	.13334
.070	.06977	.103	.10226	.136	.13430
.071	.07076	.104	.10324	.137	.13526
.072	.07175	.105	.10422	.138	.13622
.073	.07274	.106	.10520	.139	.13718
.074	.07372	.107	.10617	.140	.13814
.075	.07471	.108	.10715	.141	.13910
.076	.07570	.109	.10813	.142	.14006
.077	.07669	.110	.10910	.143	.14102
.078	.07768	111	.11008	.144	.14198
.079	.07867	.112	.11105	.145	.14294
.080	.07965	.113	.11203	.146	.14389
.081	.08064	.114	.11300	.147	.14485
.082	.08163	.115	.11397	.148	.14581
.083	.08261	.116	.11495	.149	.14676
.084	.08360	.117	.11592	.150	.14771
.085	.08458	.118	.11689	.151	.14867
.086	.08557	.119	.11786	.152	.14962
.087	.08655	.120	.11883	.153	.15057
.088	.08754	.121	.11980	.154	.15153
.089	.08852	.122	.12077	.155	.15248
.090	.08951	.123	.12174	.156	.15343
.091	.09049	.124	.12271	.157	.15438
.092	.09147	.125	.12368	.158	.15533
.093	.09246	.126	.12465	.159	.15627
.094	.09344	.127	.12562	.160	.15722
.095	.09442	.128	.12658	.161	.15817
.096	09540	.129	.12755	.162	.15911

AREAS OF THE ZONES OF A CIRCLE.

Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.
.163	.16006	.196	.19085	.229	.22072
.164	.16101	.197	.19177	.230	.22161
.165	.16195	.198	.19269	.231	.22249
.166	.16289	.199	.19361	.232	.22335
.167	.16384	.200	.19453	.233	.22426
.168	.16478	.201	.19544	.234	.22515
.169	.16572	.202	.19636	.235	.22603
.170	.16666	.203	.19727	.236	.22691
.171	.16760	.204	.19819	.237	.22780
.172	.16854	.205	.19910	.238	.22868
.173	.16948	.206	.20001	.239	.22955
.174	.17042	.207	.20092	.240	.23043
.175	.17135	.208	.20183	.241	.23131
.176	.17229	.209	.20274	.242	.23218
.177	.17323	.210	.20365	.243	.23306
.178	.17416	.211	.20455	.244	.23393
.179	.17510	.212	.20546	.245	.23480
.180	.17603	.213	.20637	.246	.23568
.181	.17696	.214	.20727	.247	.23655
.182	.17789	.215	.20817	.248	.23741
.183	.17882	.216	.20908	.249	.23828
.184	.17975	.217	.20998	.250	.23915
.185	.18068	.218	.21088	.251	.24001
.186	.18161	.219	.21178	.252	.24088
.187	.18254	.220	.21268	.253	.24174
.188	.18347	.221	.21357	.254	.24260
.189	.18439	.222	.21447	.255	.24346
.190	.18532	.223	.21536	.256	.24432
.191	.18624	.224	.21626	.257	.24518
.192	.18717	.225	.21715	.258	.24604
.193	.18809	.226	.21805	.259	.24690
.194	.18901	.227	.21894	.260	.24775
.195	.18993	.228	.21983	.261	.24860

AREAS OF THE ZONES OF A CIRCLE.

Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.
.262	.24946	.295	.27685	.328	.30265
.263	.25021	.296	.27766	.329	.30341
.264	.25116	.297	.27846	.330	.30416
.265	.25201	.298	.27927	.331	.30491
.266	.25285	.299	.28007	.332	.30566
.267	.25370	.300	.28087	.333	.30641
.268	.25454	.301	.28167	.334	.30715
.269	.25539	.302	.28247	.335	.30789
.270	.25623	.303	.28326	.336	.30864
.271	.25707	.304	.28406	.337	.30937
.272	.25791	.305	.28485	.338	.31011
.273	.25875	.306	.28564	.339	.31085
.274	.25959	.307	.28643	.340	.31158
.275	.26042	.308	.28722	.341	.31231
.276	.26126	.309	.28801	.342	.31305
.277	26209	.310	.28879	.343	.31377
.278	.26292	.311	.28958	.344	.31450
.279	.26375	.312	.29036	.345	.31523
.280	.26458	.313	.29114	.346	.31595
.281	.26541	.314	.29192	.347	.31667
.282	.26624	.315	.29270	.348	.31739
.283	26706	.316	.29347	.349	.31811
.284	26788	.317	.29425	.350	.31882
.285	.26871	.318	.29502	.351	.31953
.286	.26953	.319	.29579	.352	.32024
.287	.27035	.320	.29656	.353	.32095
.288	.27117	.321	.29733	.354	.32166
.289	.27198	.322	.29809	.355	.32237
.290	.27280	.323	.29886	.356	.32307
.291	.27361	.324	.29962	.357	.32377
.292	.27442	.325	.30038	.358	.32447
.293	.27523	.326	.30114	.359	.32517
.294	.27604	.327	.30190	.360	.32586

AREAS OF THE ZONES OF A CIRCLE.

Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.
.361	.32655	.394	.34817	.427	.36698
.362	.32725	.395	.34879	.428	.36750
.363	.32793	.396	.34940	.429	.36801
.364	.32862	.397	.35001	.430	.36853
.365	.32931	.398	.35061	.431	.36904
.366	.32999	.399	.35122	.432	.36954
.367	.33067	.400	.35182	.433	.37004
.368	.33135	.401	.35242	.434	.37054
.369	.33202	.402	.35301	.435	.37104
.370	.33270	.403	.35361	.436	.37153
.371	.33337	.404	.35420	.437	.37201
.372	.33404	.405	.35479	.438	.37250
.373	.33470	.406	.35537	.439	.37298
.374	.33537	.407	.35595	.440	.37346
.375	.33603	.408	.35653	.441	.37393
.376	.33669	.409	.35711	.442	.37440
.377	.33735	.410	.35768	.443	.37486
.378	.33801	.411	.35825	.444	.37533
.379	.33866	.412	.35882	.445	.37578
.380	.33931	.413	.35939	.446	.37624
.381	.33996	.414	.35995	.447	.37669
.382	.34060	.415	.36051	.448	.37713
.383	.34125	.416	.36107	.449	.37758
.384	.34189	.417	.36162	.450	.37801
.385	.34253	.418	.36217	.451	.37845
.386	.34317	.419	.36272	.452	.37888
.387	.34380	.420	.36326	.453	.37930
.388	.34443	.421	.36380	.454	.37972
.389	.34506	.422	.36434	.455	.38014
.390	.34569	.423	.36487	.456	.38055
.391	.34631	.424	.36541	.457	.38096
.392	.34694	.425	.36593	.458	.38136
.393	.34756	.426	.36646	.459	.38176

AREAS OF THE ZONES OF A CIRCLE.

Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.	Versed Sine.	Area of Segment.
.460	.38216	.474	.38715	.488	.39095
.461	.38255	.475	.38746	.489	.39116
.462	.38293	.476	.38777	.490	.39137
.463	.38331	.477	.38808	.491	.39156
.464	.38369	.478	.38837	.492	.39174
.465	.38406	.479	.38866	.493	.39120
.466	.38442	.480	.38895	.494	.39208
.467	.38478	.481	.38922	.495	.39222
.468	.38514	.482	.38949	.496	.39236
.469	.38549	.483	.38975	.497	.39248
.470	.38583	.484	.39001	.498	.39258
.471	.38617	.485	.39026	.499	.39265
.472	.38650	.486	.39050	.500	.39269
.473	.38683	.487	.39073		

USE OF THE ABOVE TABLE.

TO FIND THE AREA OF A CIRCULAR ZONE.—*Rule* 1. When the zone is less than a semicircle, divide the height by the longest chord, and seek the quotient in the column of versed sines. Take out the corresponding area, in the next column on the right hand, and multiply it by the square of the longest chord: the product will be the area of the zone.

Example.—Required the area of a zone, whose longest chord is 50, and height 15.

$15 \div 50 = .300$: and .300, as per table, $= .28087$.
Hence, $.28087 \times 50^2 = 702.19$, the area of the zone.

Rule 2.—*When the zone is greater than a semicircle*, take the height on each side of the diameter of the circle, and find, by Rule 1, their respective areas: the areas of these two portions, added together, will be the area of the zone.

TABLE

OF THE

AREAS OF THE SEGMENTS OF A CIRCLE,

The Diameter of which is Unity, and supposed to be divided into 1000 equal Parts.

Height.	Area.	Height.	Area.	Height.	Area.
.001	.000042	.022	.004322	.043	.011734
.002	.000119	.023	.004619	.044	.012142
.003	.000219	.024	.004922	.045	.012555
.004	.000337	.025	.005231	.046	.012971
.005	.000471	.026	.005546	.047	.013393
.006	.000619	.027	.005867	.048	.013818
.007	.000779	.028	.006194	.049	.014248
.008	.000952	.029	.006527	.050	.014681
.009	.001135	.030	.006866	.051	.015119
.010	.001329	.031	.007209	.052	.015561
.011	.001533	.032	.007559	.053	.016008
.012	.001746	.033	.007913	.054	.016458
.013	.001969	.034	.008273	.055	.016912
.014	.002199	.035	.008638	.056	.017369
.015	.002438	.036	.009008	.057	.017831
.016	.002685	.037	.009383	.058	.018297
.017	.002940	.038	.009763	.059	.018766
.018	.003202	.039	.010148	.060	.019239
.019	.003472	.040	.010538	.061	.019716
.020	.003749	.041	.010932	.062	.020197
.021	.004032	.042	.011331	.063	.020681

AREAS OF THE SEGMENTS OF A CIRCLE.

Height.	Area.	Height.	Area.	Height.	Area.
.064	.021168	.097	.039087	.130	.059999
.065	.021660	.098	.039681	.131	.060673
.066	.022155	.099	.040277	.132	.061349
.067	.022653	.100	.040875	.133	.062027
.068	.023155	.101	.041477	.134	.062707
.069	.023660	.102	.042081	.135	.063389
.070	.024168	.103	.042687	.136	.064074
.071	.024680	.104	.043296	.137	.064761
.072	.025196	.105	.043908	.138	.065449
.073	.025714	.106	.044523	.139	.066140
.074	.026236	.107	.045140	.140	.066833
.075	.026761	.108	.045759	.141	.067528
.076	.027290	.109	.046381	.142	.068225
.077	.027821	.110	.047006	.143	.068924
.078	.028356	111	.047633	.144	.069626
.079	.028894	.112	.048262	.145	.070329
.080	.029435	.113	.048894	.146	.071034
.081	.029979	.114	.049529	.147	.071741
.082	.030526	.115	.050165	.148	.072450
.083	.031077	.116	.050805	.149	.073162
.084	.031630	.117	.051446	.150	.073875
.085	.032186	.118	.052090	.151	.074590
.086	.032746	.119	.052737	.152	.075307
.087	.033308	.120	.053385	.153	.076026
.088	.033873	.121	.054037	.154	.076747
.089	.034441	.122	.054690	.155	.077470
.090	.035012	.123	.055346	.156	.078194
.091	.035586	.124	.056004	.157	.078921
.092	.036162	.125	.056664	.158	.079650
.093	.036742	.126	.057327	.159	.080380
.094	.037324	.127	.057991	.160	.081112
.095	.037909	.128	.058658	.161	.081847
.096	038497	.129	.059328	.162	.082582

AREAS OF THE SEGMENTS OF A CIRCLE.

Height.	Area.	Height.	Area.	Height.	Area.
.163	.083320	.196	.108636	.229	.135624
.164	.084060	.197	.109431	.230	.136465
.165	.084801	.198	.110227	.231	.137307
.166	.085545	.199	.111025	.232	.138151
.167	.086290	.200	.111824	.233	.138996
.168	.087037	.201	.112625	.234	.139842
.169	.087785	.202	.113427	.235	.140689
.170	.088536	.203	.114231	.236	.141538
.171	089288	.204	115036	.237	.142388
.172	.090042	.205	.115842	.238	.143239
.173	.090797	.206	.116651	.239	.144091
.174	.091555	.207	.117460	.240	.144945
.175	.092314	.208	.118271	.241	.145800
.176	.093074	.209	.119083	.242	.146655
.177	.093837	.210	.119898	.243	.147513
.178	.094601	.211	.120713	.244	.148371
.179	.095367	.212	.121530	.245	.149231
.180	.096135	.213	.122348	.246	.150091
.181	.096904	.214	.123167	.247	.150953
.182	.097675	.215	.123988	.248	.151816
.183	.098447	.216	.124811	.249	.152681
.184	.099221	.217	.125634	.250	.153546
.185	.099997	.218	.126459	.251	.154413
.186	.100774	.219	.127286	.252	.155281
.187	.101533	.220	.128114	.253	156149
.188	.102334	.221	.128943	.254	.157019
.189	.103116	.222	.129773	.255	.157891
.190	.103900	.223	.130605	.256	.158763
.191	.104686	.224	.131438	.257	.159636
.192	.105472	.225	.132273	.258	.160511
.193	.106261	.226	.133109	.259	.161386
.194	.107051	.227	.133946	.260	.162263
.195	.107843	.228	.134784	.261	.163141

AREAS OF THE SEGMENTS OF A CIRCLE.

Height.	Area.	Height.	Area.	Height.	Area.
.262	.164020	.295	.193597	.328	.224154
.263	.164900	.296	.194509	.329	.225094
.264	.165781	.297	.195423	.330	.226034
.265	.166663	.298	.196337	.331	.226974
.266	.167546	.299	.197252	.332	.227916
.267	.168431	.300	.198168	.333	.228858
.268	.169316	.301	.199085	.334	.229801
.269	.170202	.302	.200003	.335	.230745
.270	.171090	.303	.200922	.336	.231689
.271	.171978	.304	.201841	.337	.232634
.272	.172868	.305	.202762	.338	.233580
.273	.173758	.306	.203683	.339	.234526
.274	.174650	.307	.204605	.340	.235473
.275	.175542	.308	.205528	.341	.236421
.276	.176436	.309	.206452	.342	.237369
.277	.177330	.310	.207376	.343	.238319
.278	.178226	.311	.208302	.344	.239268
.279	.179122	.312	.209228	.345	.240219
.280	.180020	.313	.210155	.346	.241170
.281	.180918	.314	.211083	.347	.242122
.282	.181818	.315	.212011	.348	.243074
.283	.182718	.316	.212941	.349	.244027
.284	.183619	.317	.213871	.350	.244980
.285	.184522	.318	.214802	.351	.245935
.286	.185425	.319	.215734	.352	.246890
.287	.186329	.320	.216666	.353	.247845
.288	.187235	.321	.217600	.354	.248801
.289	.188141	.322	.218534	.355	.249758
.290	.189048	.323	.219469	.356	.250715
.291	.189956	.324	.220404	.357	.251673
.292	.190865	.325	.221341	.358	.252632
.293	.191774	.326	.222278	.359	.253591
.294	.192685	.327	.223216	.360	.254551

AREAS OF THE SEGMENTS OF A CIRCLE.

Height.	Area.	Height.	Area.	Height.	Area.
.361	.255511	.394	.287499	.427	.319959
.362	.256472	.395	.288476	.428	.320949
.363	.257433	.396	.289454	.429	.321938
.364	.258395	.397	.290432	.430	.322928
.365	.259358	.398	.291411	.431	.322919
.366	.260321	.399	.292390	.432	.324909
.367	.261285	.400	.293370	.433	.325900
.368	.262249	.401	.294350	.434	.326891
.369	.263214	.402	.295330	.435	.327883
.370	.264179	.403	.296311	.436	.328874
.371	.265145	.404	.297292	.437	.329866
.372	.266111	.405	.298274	.438	.330858
.373	.267078	.406	.299256	.439	.331851
.374	.268046	.407	.300238	.440	.332843
.375	.268014	.408	.301221	.441	.333836
.376	.269982	.409	.302204	.442	.334829
.377	.270951	.410	.303187	.443	.335823
.378	.271921	.411	.304171	.444	.336816
.379	.272891	.412	.305156	.445	.337810
.380	.273861	.413	306140	.446	.338804
.381	.274832	.414	.307125	.447	.339799
.382	.275804	.415	.308110	.448	.340793
.383	.276776	.416	.309096	.449	.341788
.384	.277748	.417	.310082	.450	.342783
.385	.278721	.418	.311068	.451	.343778
.386	.279695	.419	.312055	.452	.344773
.387	.280669	.420	.313042	.453	.345768
.388	.281643	.421	.314029	.454	.346764
.389	.282618	.422	.315017	.455	.347760
.390	.283593	.423	.316005	.456	.348756
.391	.284569	.424	.316993	.457	.349752
.392	.285545	.425	.317981	.458	.350749
.393	.286521	.426	.318970	.459	.351745

AREAS OF THE SEGMENTS OF A CIRCLE.

Height.	Area.	Height.	Area.	Height.	Area.
.460	.352742	.474	.366711	.488	.380700
.461	.353739	.475	.367710	.489	.381700
.462	.354736	.476	.368708	.490	.382700
.463	.355733	.477	.369707	.491	.383700
.464	.356730	.478	.370706	.492	.384699
.465	.357728	.479	.371705	.493	.385699
.466	.358725	.480	.372704	.494	.386699
.467	.359723	.481	.373704	.495	.387699
.468	.360721	.482	.374703	.496	.388699
.469	.361719	.483	.375702	.497	.389699
.470	.362717	.484	.376702	.498	.390699
.471	.363715	.485	.377701	.499	.391699
.472	.364714	.486	.378701	.500	.392699
.473	.365712	.487	.379701		

TABLE OF THE CURVATURE OF THE EARTH.

Dist. in miles.	Height.	Dist. in miles.	Height.	Dist. in miles.	Height.
	Ft. In.		Ft. In.		Ft.
¼	½	10	66 4	25	415
½	2	11	80 2	30	599
1	8	12	95 4	35	814
2	2 6	13	112 0	40	1064
3	6 0	14	130 0	45	1346
4	10 6	15	149 0	50	1662
5	16 6	16	170 0	60	2394
6	23 9	17	192 0	70	3258
7	32 5	18	215 0	80	4255
8	42 5	19	240 0	90	5386
9	53 8	20	266 0	100	6649

TABLE

OF

THE LENGTHS OF CIRCULAR ARCS WHOSE BASE IS UNITY.

Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.
.101	1.02698	.122	1.03923	.143	1.05367
.102	1.02752	.123	1.03987	.144	1.05441
.103	1.02806	.124	1.04051	.145	1.05516
.104	1.02860	.125	1.04116	.146	1.05591
.105	1.02914	.126	1.04181	.147	1.05667
.106	1.02970	.127	1.04247	.148	1.05743
.107	1.03026	.128	1.04313	.149	1.05819
.108	1.03082	.129	1.04380	.150	1.05896
.109	1.03139	.130	1.04447	.151	1.05973
.110	1.03196	.131	1.04515	.152	1.06051
.111	1.03254	.132	1.04584	.153	1.06130
.112	1.03312	.133	1.04652	.154	1.06209
.113	1.03371	.134	1.04722	.155	1.06288
.114	1.03430	.135	1.04792	.156	1.06368
.115	1.03490	.136	1.04862	.157	1.06449
.116	1.03551	.137	1.04932	.158	1.06530
.117	1.03611	.138	1.05003	.159	1.06611
.118	1.03672	.139	1.05075	.160	1.06693
.119	1.03734	.140	1.05147	.161	1.06775
.120	1.03797	.141	1.05220	.162	1.06858
.121	1.03860	.142	1.05293	.163	1.06941

Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.
.164	1.07025	.197	1.10048	.230	1.13557
.165	1.07109	.198	1.10147	.231	1.13671
.166	1.07194	.199	1.10247	.232	1.13786
.167	1.07279	.200	1.10348	.233	1.13903
.168	1.07365	.201	1.10447	.234	1.14020
.169	1.07451	.202	1.10548	.235	1.14136
.170	1.07537	.203	1.10650	.236	1.14247
.171	1.07624	.204	1.10752	.237	1.14363
.172	1.07711	.205	1 10855	.238	1.14480
.173	1.07799	.206	1.10958	.239	1.14597
.174	1.07888	.207	1.11062	.240	1.14714
.175	1.07977	.208	1.11165	.241	1.14831
.176	1.08066	.209	1.11269	.242	1.14949
.177	1.08156	.210	1.11374	.243	1.15067
.178	1.08246	.211	1.11479	.244	1.15186
.179	1.08337	.212	1.11584	.245	1.15308
.180	1.08428	.213	1 11692	.246	1.15429
.181	1.08519	.214	1.11796	.247	1.15549
.182	1.08611	.215	1.11904	.248	1.15670
.183	1.08704	.216	1.12011	.249	1.15791
.184	1.08797	.217	1.12118	.250	1.15912
.185	1.08890	.218	1.12225	.251	1.16033
.186	1.08984	.219	1.12334	.252	1.16157
.187	1.09079	.220	1.12445	.253	1.16279
.188	1.09174	.221	1.12556	.254	1.16402
.189	1 09269	.222	1.12663	.255	1.16526
.190	1.09365	.223	1.12774	.256	1.16649
.191	1.09461	.224	1.12885	.257	1.16774
.192	1.09557	.225	1.12997	.258	1.16899
.193	1.09654	.226	1.13108	.259	1.17024
.194	1.09752	.227	1.13219	.260	1.17150
.195	1.09850	.228	1.13331	.261	1.17275
.196	1 09949	.229	1.13444	.262	1.17401

Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.
.263	1.17527	.296	1.21926	.329	1.26740
.264	1.17655	.297	1.22061	.330	1.26892
.265	1.17784	.298	1.22203	.331	1.27044
.266	1.17912	.299	1.22347	.332	1.27196
.267	1.18040	.300	1.22495	.333	1.27349
.268	1.18162	.301	1.22635	.334	1.27502
.269	1.18294	.302	1.22776	.335	1.27656
.270	1.18428	.303	1.22918	.336	1.27810
.271	1.18557	.304	1.23061	.337	1.27864
.272	1.18688	.305	1.23205	.338	1.28118
.273	1.18819	.306	1.23349	.339	1.28273
.274	1.18969	.307	1.23494	.340	1.28428
.275	1.19082	.308	1.23636	.341	1.28583
.276	1.19214	.309	1.23780	.342	1.28739
.277	1.19345	.310	1.23925	.343	1.28895
.278	1.19477	.311	1.24070	.344	1.29052
.279	1.19610	.312	1.24216	.345	1.29209
.280	1.19743	.313	1.24360	.346	1.29366
.281	1.19887	.314	1.24506	.347	1.29523
.282	1.20011	.315	1.24654	.348	1.29681
.283	1.20146	.316	1.24801	.349	1.29839
.284	1.20282	.317	1.24946	.350	1.29997
.285	1.20419	.318	1.25095	.351	1.30156
.286	1.20558	.319	1.25243	.352	1.30315
.287	1.20696	.320	1.25391	.353	1.30474
.288	1.20828	.321	1.25539	.354	1.30634
.289	1.20967	.322	1.25686	.355	1.30794
.290	1.21202	.323	1.25836	.356	1.30954
.291	1.21239	.324	1.25987	.357	1.31115
.292	1.21381	.325	1.26137	.358	1.31276
.293	1.21520	.326	1.26286	.359	1.31437
.294	1.21658	.327	1.26437	.360	1.31599
.295	1.21794	.328	1.26588	.361	1.31761

Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.
.362	1.31923	.395	1.37455	.428	1.43309
.363	1.32086	.396	1.37628	.429	1.43491
.364	1.32249	.397	1.37801	.430	1.43673
.365	1.32413	.398	1.37974	.431	1.43856
.366	1.32577	.399	1.38148	.432	1.44039
.367	1.32741	.400	1.38322	.433	1.44222
.368	1.32905	.401	1.38496	.434	1.44405
.369	1.33069	.402	1.38671	.435	1.44589
.370	1.33234	.403	1.38846	.436	1.44773
.371	1.33399	.404	1.39021	.437	1.44957
.372	1.33564	.405	1.39196	.438	1.45142
.373	1.33730	.406	1.39372	.439	1.45327
.374	1.33896	.407	1.39548	.440	1.45512
.375	1.34063	.408	1.39724	.441	1.45697
.376	1.34229	.409	1.39900	.442	1.45883
.377	1.34396	.410	1.40077	.443	1.46069
.378	1.34563	.411	1.40254	.444	1.46255
.379	1.34731	.412	1.40432	.445	1.46441
.380	1.34899	.413	1.40610	.446	1.46628
.381	1.35068	.414	1.40788	.447	1.46815
.382	1.35237	.415	1.40966	.448	1.47002
.383	1.35406	.416	1.41145	.449	1.47189
.384	1.35575	.417	1.41324	.450	1.47377
.385	1.35744	.418	1.41503	.451	1.47565
.386	1.35914	.419	1.41682	.452	1.47753
.387	1.36084	.420	1.41861	.453	1.47942
.388	1.36254	.421	1.42041	.454	1.48131
.389	1.36425	.422	1.42222	.455	1.48320
.390	1.36596	.423	1.42402	.456	1.48509
.391	1.36767	.424	1.42583	.457	1.48699
.392	1.36939	.425	1.42764	.458	1.48889
.393	1.37111	.426	1.42945	.459	1.49079
.394	1.37283	.427	1.43127	.460	1.49269

CIRCULAR ARCS.

Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.	Height of Arc.	Length of Arc.
.461	1.49460	.475	1.52152	.489	1.54893
.462	1.49651	.476	1.52346	.490	1.55098
.463	1.49842	.477	1.52541	.491	1.55280
.464	1.50033	.478	1.52736	.492	1.55486
.465	1.50224	.479	1.52931	.493	1.55685
.466	1.50416	.480	1.53126	.494	1.55854
.467	1.50608	.481	1.53322	.495	1.56083
.468	1.50800	.482	1.53518	.496	1.56282
.469	1.50992	.483	1.53714	.497	1.56481
.470	1.51185	.484	1.53910	.498	1.56680
.471	1.51378	.485	1.54106	.499	1.56879
.472	1.51571	.486	1.54302	.500	1.57079
.473	1.51764	.487	1.54499		
.474	1.51958	.488	1.54696		

To find the length of an arc of a circle by the table:

Rule.—Divide the height by the base, and the quotient will be the height of an arc of which the base is unity. Multiply the tabular number opposite the corresponding quotient by the base of the arc, and the product equals the length of the curve required.

TABLE

EXHIBITING THE WEIGHT OF A LINEAL FOOT OF FLAT BAR IRON IN POUNDS.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
½	⅛	0.210	1	⅛	1.690
	¼	0.422		¼	2.112
	⅜	0.634		⅜	2.534
⅝	⅛	0.263		½	2.956
	¼	0.528	1⅛	⅛	0.475
	⅜	0.792		¼	0.940
	½	1.056		⅜	1.425
¾	⅛	0.313		½	1.901
	¼	0.633		⅝	2.375
	⅜	0.950		¾	2.850
	½	1.265		⅞	3.326
	⅝	1.584	1		3.802
⅞	⅛	0.367	1¼	⅛	0.528
	¼	0.738		¼	1.056
	⅜	1.108		⅜	1.584
	½	1 477		½	2.112
	⅝	1.846		⅝	2.640
	¾	2.217		¾	3.168
1	⅛	0.422		⅞	3.696
	¼	0.835	1		4.224
	⅜	1.267	1⅛		4.752

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
1⅜	⅛	0.580	1¾	⅛	0.739
	¼	1.161		¼	1.459
	⅜	1.742		⅜	2.218
	½	2.305		½	2.937
	⅝	2.904		⅝	3.696
	¾	3 484		¾	4.435
	⅞	4.065		⅞	5.178
	1	4.646		1	5.914
	1⅛	5.227		1⅛	6.653
	1¼	5.808		1¼	7.393
1½	⅛	0.633		1⅜	8.132
	¼	1.266		1½	8.871
	⅜	1.900		1⅝	9.610
	½	2.505	1⅞	⅛	0.792
	⅝	3.168		¼	1.584
	¾	3.802		⅜	2.376
	⅞	4.435		½	3.168
	1	5.069		⅝	3.960
	1⅛	5.703		¾	4.752
	1¼	6.337		⅞	5.544
	1⅜	6.970		1	6.336
1⅝	⅛	0.686		1⅛	7.129
	¼	1.372		1¼	7.921
	⅜	2.059		1⅜	8.713
	½	2.746		1½	9.505
	⅝	3.432		1⅝	10.297
	¾	4.119		1¾	11.089
	⅞	4.805	2	⅛	0.845
	1	5.492		¼	1.669
	1⅛	6 178		⅜	2.534
	1¼	6.864		½	3.379
	1⅜	7.551		⅝	4.224
	1½	8.237		¾	5.069

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
2	7/8	5.914	2 1/4	1 1/8	8.554
	1	6.758		1 1/4	9.505
	1 1/8	7.604		1 3/8	10.455
	1 1/4	8.448		1 1/2	11.406
	1 3/8	9.294		1 5/8	12.356
	1 1/2	10.138		1 3/4	13.307
	1 5/8	10.983		1 7/8	14 257
	1 3/4	11.828		2	15.108
	1 7/8	12.673		2 1/8	16.158
2 1/8	1/8	0.898	2 3/8	1/8	1.003
	1/4	1.795		1/4	2.006
	3/8	2.693		3/8	3.009
	1/2	3.561		1/2	4.013
	5/8	4.488		5/8	5.016
	3/4	5.386		3/4	6.019
	7/8	6.283		7/8	7.022
	1	7.181		1	8.025
	1 1/8	8.079		1 1/8	9.028
	1 1/4	8.977		1 1/4	10.032
	1 3/8	9.874		1 3/8	11.035
	1 1/2	10.772		1 1/2	12.038
	1 5/8	11.670		1 5/8	13.042
	1 3/4	12.567		1 3/4	14.045
	1 7/8	13.465		1 7/8	15.048
	2	14.332		2	16.051
2 1/4	1/8	0.950		2 1/8	17 054
	1/4	1.900		2 1/4	18.057
	3/8	2.851	2 1/8	1/8	1.056
	1/2	3.802		1/4	2.112
	5/8	4.752		3/8	3.168
	3/4	5.703		1/2	4.224
	7/8	6 653		5/8	5.280
	1	7.504		3/4	6 336

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
2½	⅞	7.392	2¾	1/16	1.162
	1	8 448		1/8	2 323
	1 1/16	9 504		3/16	3.485
	1 1/8	10.560		¼	4.647
	1 3/16	11.616		5/16	5.808
	1 ¼	12.672		⅜	6.970
	1 5/16	13.728		7/16	8.132
	1 3/8	14 784		1	9.294
	1 7/16	15.840		1 1/16	10.455
	2	16.896		1 1/8	11.617
	2 1/16	17.952		1 3/16	12.779
	2 1/8	19.008		1 ¼	13.940
	2 3/16	20.064		1 5/16	15.102
2⅝	1/16	1.109		1 3/8	16.264
	1/8	2.218		1 7/16	17.425
	3/16	3.327		2	18.587
	¼	4.436		2 1/16	19.749
	5/16	5.545		2 1/8	20.910
	⅜	6.654		2 3/16	22.072
	7/16	7.763		2 ¼	23.234
	1	8.872		2 5/16	24.395
	1 1/16	9.981	2⅞	1/16	1.215
	1 1/8	11.090		1/8	2.429
	1 3/16	12.199		3/16	3.644
	1 ¼	13.308		¼	4.858
	1 5/16	14.417		5/16	6.072
	1 3/8	15.526		⅜	7.287
	1 7/16	16.635		7/16	8.502
	2	17 744		1	9 716
	2 1/16	18.853		1 1/16	10.931
	2 1/8	19.962		1 1/8	12 145
	2 3/16	21.071		1 3/16	13 360
	2 ¼	22.180		1 ¼	14 574

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
2⅞	1⅛	15.789	3½	⅛	6.865
	1¼	17.003		¼	8.237
	1⅜	18 218		⅜	9.610
	2	19.432		1	10.983
	2⅛	20.647		1⅛	12 356
	2¼	21.861		1¼	13.730
	2⅜	23.076		1⅜	15.102
	2½	24.290		1½	16.475
	2⅝	25 505		1⅝	17.848
	2¾	26.719		1¾	19.221
3	⅛	1.267		1⅞	20.594
	¼	2.535		2	21.967
	⅜	3.802		2¼	24.712
	½	5.069		2½	27.458
	⅝	6.337		2¾	30.204
	¾	7.604		3	32.950
	⅞	8.871	3½	⅛	1.479
	1	10.138		¼	2.957
	1⅛	11.406		⅜	4.436
	1¼	12.673		½	5.914
	1⅜	13.940		⅝	7.393
	1½	15.208		¾	8.871
	1⅝	16.475		⅞	10.350
	1¾	17.742		1	11.828
	1⅞	19.010		1⅛	13.307
	2	20.277		1¼	14.785
	2¼	22.811		1⅜	16.264
	2½	25.346		1½	17.742
	2¾	27.881		1⅝	19.221
3¼	⅛	1.373		1¾	20.699
	¼	2.746		1⅞	22.178
	⅜	4.119		2	23.656
	½	5.492		2¼	26.613

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
3½	2⅜	29.570	4	1⅞	23.656
	2¾	32.527		2	27.036
	3	35.485		2⅛	30.415
	3⅛	38.441		2¼	33.795
3¾	⅛	1.584		2⅜	37.174
	¼	3.168		3	40.554
	⅜	4.752		3⅛	43.933
	½	6.336		3¼	47.313
	⅝	7.921		3⅜	50.692
	¾	9.505	4¼	⅛	1.795
	⅞	11.089		¼	3.591
	1	12.673		⅜	7 181
	1⅛	14.257		½	10.772
	1¼	15.841		1	14.334
	1⅜	17.425		1⅛	17.953
	1½	19.009		1¼	21.544
	1⅝	20.594		1⅜	25 135
	1¾	22.178		2	28.725
	1⅞	23.762		2⅛	32.316
	2	25.346		2¼	35.907
	2⅛	28.514		2⅜	39.497
	2¼	31 682		3	43.088
	2⅜	34.851		3⅛	46.679
	3	38.019		3¼	50.269
	3⅛	41.187		3⅜	53.860
	3¼	44.355		4	57.420
4	⅛	1.690	4½	¼	3.802
	¼	3.380		½	7.604
	⅜	6.759		¾	11.406
	½	10.138		1	15.208
	1	13.518		1¼	19.010
	1¼	16.897		1½	22.812
	1½	20 277		1¾	26.614

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
4½	2	30.415	5	1⅛	25.346
	2¼	34.217		1¼	29.570
	2⅜	38.019		2	33.755
	2½	41.820		2¼	38.019
	3	45.623		2⅜	42.243
	3¼	49.425		2½	46.468
	3⅜	53.226		3	50.602
	3½	57.028		3¼	54.916
	4	60 830		3⅜	59.140
	4¼	64.632		3½	63.365
4¾	¼	4.003		4	67.589
	⅜	8.026		4¼	71.813
	½	12.038		4⅜	76.038
	I	16.052		4½	80.262
	1¼	20.066	5¼	¼	4.436
	1⅜	24.079		⅜	8.871
	1½	28 092		½	13.307
	2	32.105		I	17.722
	2¼	36.118		1¼	22.178
	2⅜	40.131		1⅜	26.613
	2½	44 144		1½	31.049
	3	48 157		2	35.484
	3¼	52.170		2¼	39 920
	3⅜	56.184		2⅜	44.355
	3½	60.197		2½	48 791
	4	64.210		3	53.226
	4¼	68.223		3¼	57.662
	4⅜	72.235		3⅜	62.097
5	¼	4.224		3½	66.533
	⅜	8.449		4	70.938
	½	12.673		4¼	75.404
	I	16.867		4⅜	79 839
	1¼	21.122		4½	84.275

FLAT BAR IRON.

Breadth in inch.	Thick's in inch.	Weight in pounds.	Breadth in inch.	Thick's in inch.	Weight in pounds.
5	5	88.710	5	2¾	51.114
5¼	¼	4.647		3	55.761
	½	9.294		3¼	60.408
	¾	13.940		3½	65.055
	1	18.587		3¾	69.701
	1¼	23.234		4	74.348
	1½	27.881		4¼	78.995
	1¾	32.527		4½	83.642
	2	37.174		4¾	88.288
	2¼	41.821		5	92.935
	2½	46.468			

LEAD PIPES.

Bore in inches.	Length in feet.	The Weight of each Length in pounds.		
		Light.	Midd.	Strong.
½	15	15	17	22
⅝	"	17	20	24
¾	"	24	28	32
1	"	36	42	50
1¼	12	36	42	52
1½	"	48	56	64
1¾	"	76	84	96
2	"	84	96	112

WIRE.

The Weight of 100 lineal feet.

B. W. Gauge.	Iron.	Steel.	Brass.	Copper.
	lbs.	lbs.	lbs.	lbs.
0	30.58	30.92	33.43	35.17
1	23.81	24.07	26.03	27.38
2	21.34	21.57	23.32	24.58
3	18.02	18.22	19.70	20.72
4	15.11	15.28	16.52	17.38
5	12.46	12.59	13.61	14.32
6	11.44	11.57	12.51	13.16
7	8.57	8.67	9.37	9.86
8	7.29	7.37	7.97	8.38
9	5.80	5.86	6.34	6.67
10	4.96	5.02	5.42	5.71
11	4.13	4.17	4.51	4.75
12	3.14	3.18	3.43	3.61
13	2.34	2.36	2.55	2.69
14	1.69	1.71	1.85	1.94
15	1.37	1.39	1.50	1.57
16	1.05	1.06	1.14	1.21
17	.80	.81	.87	.92
18	.61	.61	.67	.70
19	.47	.47	.51	.54
20	.32	.33	.34	.37

WEIGHT OF MALLEABLE FLAT IRON IN LBS. PER LINEAL FOOT.

Breadth of Plate (inches).	Thickness in Fractions of an Inch.					
	1/16	1/8	3/16	1/4	5/16	3/8
1	.21	.42	.63	.83	1.04	1.25
1 1/4	.26	.52	.78	1.04	1.30	1 56
1 2/4	.31	.63	.94	1.25	1.56	1.88
1 3/4	.36	.73	1.09	1.46	1.82	2.19
2	.42	.83	1.25	1.67	2.08	2.50
2 1/4	.47	.94	1.41	1.88	2.34	2.81
2 2/4	.52	1.04	1.56	2 08	2.60	3.13
2 3/4	.57	1.15	1.72	2.29	2.86	3.44
3	.63	1.25	1.88	2.50	3.13	3.75
3 1/4	.68	1.35	2.03	2.71	3.39	4.06
3 2/4	.73	1.46	2.19	2.92	3 65	4.38
3 3/4	.78	1.56	2.34	3 13	3 91	4.69
4	.83	1.67	2 50	3.33	4.17	5.00
4 1/4	.89	1.77	2.66	3 54	4.43	5 31
4 2/4	.94	1.88	2.81	3.75	4.69	5.63
4 3/4	.99	1.98	2.97	3.96	4.95	5.94
5	1.04	2.08	3.13	4.17	5.21	6.25
5 1/4	1.09	2.19	3.28	4.38	5.47	6.56
5 2/4	1.15	2 29	3.44	4.58	5.73	6.88
5 3/4	1.20	2.40	3.59	4.79	5.99	7.19
6	1.25	2.50	3.75	5.00	6.25	7.50

WEIGHT OF MALLEABLE FLAT IRON IN LBS. PER LINEAL FOOT—*continued.*

Breadth of Plate (inches).	Thickness in Fractions of an Inch.				
	7/16	1/2	9/16	5/8	11/16
1	1.46	1.67	1.88	2.08	2.29
1 1/4	1.82	2.08	2.34	2.60	2.86
1 1/2	2.19	2.50	2.81	3.13	3.44
1 3/4	2.55	2.92	3.28	3.65	4 01
2	2.92	3.33	3.75	4.17	4.58
2 1/4	3.28	3 75	4.22	4.69	5.16
2 1/2	3.65	4.17	4.69	5.21	5.73
2 3/4	4.01	4.58	5.16	5.73	6.30
3	4.38	5.00	5.63	6.25	6.88
3 1/4	4.74	5.42	6.09	6.77	7.45
3 1/2	5.10	5.83	6.56	7.29	8 02
3 3/4	5.47	6.25	7.03	7 81	8.59
4	5.83	6.67	7 50	8.33	9.17
4 1/4	6.20	7.08	7.97	8.85	9.74
4 1/2	6.56	7.50	8.44	9.38	10.31
4 3/4	6.93	7.92	8.91	9.90	10.89
5	7.29	8.33	9.38	10.42	11.46
5 1/4	7.66	8.75	9.84	10.94	12.03
5 1/2	8.02	9.17	10.31	11.46	12.60
5 3/4	8.39	9.58	10.78	11.98	13.18
6	8.75	10.00	11.25	12.50	13.75

WEIGHT OF MALLEABLE FLAT IRON IN LBS. PER LINEAL FOOT—*concluded.*

Breadth of Plate (inches).	Thickness in Fractions of an Inch.				
	¾	11/16	⅞	15/16	1 inch.
1	2.50	2.71	2.92	3.13	3.33
1¼	3.13	3.39	3.65	3.91	4.16
1½	3.75	4.06	4.38	4.69	5.00
1¾	4.38	4.74	5.10	5.47	5.83
2	5.00	5.42	5.83	6.25	6.67
2¼	5.63	6 09	6.56	7.03	7.50
2½	6.25	6.77	7.29	7.81	8.33
2¾	6.88	7.45	8.02	8.59	9.17
3	7.50	8.13	8.75	9.38	10.00
3¼	8.13	8.80	9.48	10.16	10.83
3½	8.75	9.48	10.21	10.94	11.67
3¾	9.38	10.16	10.94	11.72	12.50
4	10.00	10.83	11.67	12.50	13.33
4¼	10.63	11.51	12.40	13.28	14.17
4½	11.25	12.19	13.13	14.06	15.00
4¾	11.88	12.86	13.85	14.84	15.83
5	12.50	13.54	14.58	15.63	16.67
5¼	13.13	14.22	15.31	16.41	17.50
5½	13.75	14.90	16.04	17.19	18.33
5¾	14.38	15.57	16.77	17.97	19.17
6	15.00	16.25	17.50	18.75	20.00

BIRMINGHAM GAUGE FOR WIRE, SHEET IRON AND STEEL.

Thickness by the Gauge.	Thickness.	Weight per Square Foot.				Thickness.
		Sheet and Boiler Iron.	Sheet Cast Steel.	Sheet Copper	Sheet Lead.	
No.	inch.	lbs.	lbs.	lbs.	lbs.	inch.
0000	.454	18.267	18.259	20.566	26.75	7-16
000	.425	17 053	17.280	19.252	25.06	27-64
00	.380	15.247	15.451	17.214	22.42	3-8
0	.340	13.7	14.	15.6	20.06	11-32
1	.300	12 1	12.4	13.8	17 72	5-16
2	.284	11.4	11 7	13.	16.75	9-32
3	.259	10 4	10 6	11.9	15.26	1-4
4	.238	9.6	9.8	11.	14.02	7-32
5	.220	8 85	9.02	10.1	12.98	7-32
6	.203	8.17	8.33	9.32	11.98	7-32
7	.180	7.24	7.38	8.25	10.63	3-16
8	.165	6.65	6.78	7.59	9.73	3-16
9	.148	5.96	6.08	6.8	8.72	5-32
10	.134	5.40	5 51	6.16	7.90	5-32
11	.120	4.83	4 93	5 51	7.08	1-8
12	.109	4 40	4.50	5 02	6.42	1-8
13	.095	3.83	3 91	4.37	5.60	3-32
14	.083	3.34	3.41	3.81	4.90	3-32
15	.072	2.90	2.96	3.31	4.25	1-16
16	.065	2.62	2.67	3.00	3.83	1-16

BIRMINGHAM GAUGE FOR WIRE, SHEET IRON AND STEEL.

Thickness by the Gauge.	Thickness.	Weight per Square Foot.				Thickness.
		Sheet and Boiler Iron.	Sheet Cast Steel.	Sheet Copper	Sheet Lead.	
No.	inch.	lbs.	lbs.	lbs.	lbs.	inch.
17	.058	2.34	2.39	2.67	3.42	1-16
18	.049	1.97	2 01	2.25	2.90	1-16
19	.042	1.69	1 72	1.93	2.48	3-64
20	.035	1.41	1.42	1.61	2.04	3-64
21	.032	1.29	1.31	1.47	1.89	3-64
22	.028	1.13	1.15	1.29	1.65	1-32
23	.025	1.00	1.02	1.11	1.47	1-32
24	.022	.885	.903	1.01	1.30	1-32
25	.020	.805	.820	.918	1.18	1-32
26	.018	.724	.738	.826	1.06	1-64
27	.016	.644	.657	.735	.945	1-64
28	.014	.563	.574	.642	.826	
29	.013	.523	.533	.597	.767	
30	.012	.483	.493	.551	.708	
31	.010	.402	.410	.480	.600	
32	.009	.362	.370	.420	.532	
33	.008	.322	.328	.370	.472	
34	.007	.282	.288	.323	.413	
35	.005	.230	.235	.262	.309	
36	.004	.170	.173	.194	.236	

WHITWORTH'S WIRE GAUGE IN DECIMALS OF AN INCH.

Mark.	Size.	Mark.	Size.	Mark.	Size.
1	.001	24	.024	110	.110
2	.002	26	.026	120	.120
3	.003	28	.028	135	.135
4	.004	30	.030	150	.150
5	.005	32	.032	165	.165
6	.006	34	.034	180	.180
7	.007	36	.036	200	.200
8	.008	38	.038	220	.220
9	.009	40	.040	240	.240
10	.010	45	.045	260	.260
11	.011	50	.050	280	.280
12	.012	55	.055	300	.300
13	.013	60	.060	325	.325
14	.014	65	.065	350	.350
15	.015	70	.070	375	.375
16	.016	75	.075	400	.400
17	.017	80	.080	425	.425
18	.018	85	.085	450	.450
19	.019	90	.090	475	.475
20	.020	95	.095	500	.500
22	.022	100	.100		

NEW LEGAL STANDARD WIRE GAUGE.

Issued by the Standards Department of the Board of Trade; came into force March 1st, 1884.

Descriptive Number. B.W.G.	Equivalent in Parts of an Inch.	Descriptive Number. B.W.G.	Equivalent in Parts of an Inch.	Descriptive Number. B.W.G.	Equivalent in Parts of an Inch.
No.		No.		No.	
7/0	.500	13	.092	32	.0108
6/0	.464	14	.080	33	.0100
5/0	.432	15	.072	34	.0092
4/0	.400	16	.064	35	.0084
3/0	.372	17	.056	36	.0076
2/0	.348	18	.048	37	.0068
0	.324	19	.040	38	.0060
1	.300	20	.036	39	.0052
2	.276	21	.032	40	.0048
3	.252	22	.028	41	.0044
4	.232	23	.024	42	.0040
5	.212	24	.022	43	.0036
6	.192	25	.020	44	.0032
7	.176	26	.018	45	.0028
8	.160	27	.0164	46	.0024
9	.144	28	.0148	47	.0020
10	.128	29	.0136	48	.0016
11	.116	30	.0124	49	.0012
12	.104	31	.0116	50	.0010

WEIGHT OF METALS.

Weight in lbs. of a Square Foot of Different Metals, in Thicknesses varying by $\frac{1}{16}$ of an inch.

Thickness in inches.	Wrought Iron.	Cast Iron.	Steel.	Copper.	Zinc.	Brass.	Gun Metal.	Tin.	Lead.
$\frac{1}{16}$	2.3	2.3	2.5	2.9	2.3	2.6	2.7	2.4	3.7
$\frac{1}{8}$	5.0	4.7	5 1	5.8	4.7	5.3	5.5	4.8	7.4
$\frac{3}{16}$	7.5	7 0	7.6	8.7	7.0	8.2	8.2	7.2	11.2
$\frac{1}{4}$	10.0	9.4	10.2	11.6	9.4	11.0	10.9	9.6	14.9
$\frac{5}{16}$	12.5	11.7	12.8	14.5	11.7	13.7	13.7	12.0	18.6
$\frac{3}{8}$	15.0	14.1	15.3	17.2	14.0	16.4	16.4	14.4	22.3
$\frac{7}{16}$	17.5	16.4	17.9	20.0	16 4	19.2	19.1	16.8	26 0
$\frac{1}{2}$	20.0	18.7	20 4	22.9	18 7	21.9	21.9	19.3	29.7
$\frac{9}{16}$	22.5	21.1	25.0	25.7	21.1	24.6	24 6	21.7	33.4
$\frac{5}{8}$	25.0	23.5	25.5	28.6	23.4	27.4	27.3	24.1	37.1
$\frac{11}{16}$	27.5	25.8	28.1	31 4	25.7	30.1	30 0	26.5	40.9
$\frac{3}{4}$	30.0	28.1	30.6	34.3	28.1	32.9	32.8	28.9	44.6
$\frac{13}{16}$	32.5	30 5	33.2	37.2	30.4	35.6	35.0	31.3	48 3
$\frac{7}{8}$	35.0	32.8	35.7	40.0	32.8	38.3	38.2	33.7	52 0
$\frac{15}{16}$	37.5	35.2	38.3	42.9	35.1	41.2	41.0	36.1	55.7
1	40 0	37.5	40.8	45.8	37.5	43.9	43.7	38.5	59.4

NOTE.—The weight per square foot to any gauge can easily be obtained from the above table by multiplying the weight of a square foot of the metal one inch thick by the thickness of the gauge in inches or parts of an inch.

RELATIVE WEIGHTS OF METALS.

The weight of	Bar Iron being	1.
	Cast Iron	= .95
	Steel	= 1. 2
	Copper	= 1.16
	Brass	= 1.09
	Lead	= 1.48
The weight of	Cast Iron being	1.
	Bar Iron	= 1.07
	Steel	= 1.08
	Brass	= 1.16
	Copper	= 1.21
	Lead	= 1.56
The weight of	Yellow Pine being	1.
	Cast Iron	=16.
	Steel	=17.2
	Copper	=19 3
	Brass	=18.4
	Lead	=24.
The weight of	Brass being	= 1.
	Bar Iron	= .92
	Cast Iron	= .86
	Steel	= .93
	Copper	= 1.05
	Lead	= 1.35

STRENGTH IN TONS OF SOLID CAST-IRON COLUMNS.

(SPRAGUE.)

With the ends flat and fixed, calculated at about one-tenth of the breaking weight, according to Hodgkinson's Formula,

$$W = 44.16 \frac{D^{3.6}}{L^{1.7}}$$

Where D = Diameter of Column in Inches.
" L = Length of " Feet.
" W = Breaking Weight in Tons.

The strength of a hollow column nearly equals the difference between that of two solid columns the diameters of which are equal to the external and internal diameters of the hollow one.

Strength of short column in which L is less than 30 D. Let W = breaking weight of column as found from formula above. C = crushing force per square inch of section of the metal × sectional area of column.

Then corrected breaking weight $= \frac{W.C.}{W + \frac{1}{4}C}$

The Crushing Strength of Cast Iron per square inch of section is 40 tons.

STRENGTH IN TONS OF SOLID CAST-IRON COLUMNS—*continued.*

Diameter in inches.	Length of the Column in Feet.				
	8	10	12	14	16
	Tons.	Tons.	Tons.	Tons.	Tons.
2⅜	3.16	2.16	1.58	1.22	.97
2¾	4.45	3.05	2.23	1.72	1.37
3	6.09	4.17	3 06	2.35	1.87
3½	10.60	7.26	5.32	4.10	3.26
4	17.15	11.73	8.61	5.62	5 28
4½	23 2	17.93	13.15	10.12	8.07
5	34.7	26 2	19.22	14.79	11.79
5½	41.5	33.3	27.09	20.84	16.61
6	53.0	43.0	37.05	28.51	22.72
6½	66.5	54.8	45.1	38.03	30.31
7	81.0	67.1	56.2	49.66	39.57
7½	97.3	81.6	68.8	58 6	50.73
8	115.8	97 7	83.0	71.1	64 0
8½	135.7	115.4	98.7	85.0	74 3
9	158.7	136 3	117.5	101.9	88.8
9½	180.7	156.0	135 0	117.5	102.8
10	205.7	178.7	155.7	136.1	119 1

AVERAGE NUMBER OF CUBIC FEET PER TON OF VARIOUS SUBSTANCES FOR ESTIMATING WORK OR STOWAGE.

Iron	4·7
Lead	3·2
Brick	22
Clay	22
Sand	24
Earth, loose	28
Granite	16
Oak	39·5
Ash	45
Cedar	72
Mahogany, sp	45
Deal	50
Pine, red	55
" yellow	77
Water, fresh	36
" salt	35
Coke	90
Coal (stowed)	48
Wood (equivalent) requires	288

SPECIFIC GRAVITIES AND WEIGHTS.

METALS.

——	Specific Gravity.	Weight of a cubic foot in lbs. avoir.
Aluminium	2.6	162
Antimony, cast	6.712	419
Arsenic	5.763	360
Bismuth, cast	9.822	614
Brass, cast	7.8	487
	8.4	524
" wire	8 544	534
Bronze	8.218	513
Cobalt, cast	7.812	488
Copper, cast	8.788	549
" coin	8.915	557
" wire and sheet	8.878	555
Gold, coin	17.647	1,102
" trinket	15.609	981
" pure, cast	19.258	1,203
" " hammered	19.316	1,210
Gun Metal	8.784	549
Iridium	23.	1,437
Iron, wrought	7.	474
	7.8	486
" " average	7.698	480

SPECIFIC GRAVITIES AND WEIGHTS.

METALS—*continued.*

	Specific Gravity.	Weight of a cubic foot in lbs. avoir.
Iron, meteoric	7.965	497
Lead, cast	11.352	709
" milled	11.4	712
Mercury, common, at 32°	13.568	848
" pure	14	875
" solid	15.6	977
Nickel	8.279	517
Palladium	11.8	737
Pewter	7.471	466
Platinum	21	1,311
	22	1,373
Rhodium	11	687
Silver coin	10 534	658
" pure, cast	10.744	671
Steel	7.8	487
	7.9	493
Tin, cast	7.3	456
	7.5	468
Type Metal	10.4	653
Zinc	6.8	424
	7.19	449

SPECIFIC GRAVITIES AND WEIGHTS.

Stones, Earths, &c.

—	Specific gravity.	Weight of a cubic foot in lbs. avoir.
Amber	1.078	67
Asbestos	2.996	187
Asphalte, gritted	2 5	156
Basalt	2.864	180
Bathstone	1.97	123
Bermuda stone, hard	2.62	164
" " soft	1.47	92
Beryl, oriental	3.549	221
Bitumen	1	62
Brick, common stock	1.8	115
" red facing	2	130
" fire	2.4	150
Brickwork in mortar	1.6	100
" in cement	1.8	110
Caen stone	2	125
Cement, Portland	1.2	87
" Roman	.9	60
Chalk, solid	1 8	112
	2.8	175
" in lumps	—	87
Clay, potters'	1.9	120
" with gravel	2	130
" ordinary	1.9	120
Coal, anthracite	1.602	100
" bituminous	1.24	77
	1.44	90
Coke	.7	47

SPECIFIC GRAVITIES AND WEIGHTS.

STONES, EARTHS, &c.—*continued.*

—	Specific gravity.	Weight of a cubic foot in lbs. avoir.
Concrete, Portland	1.9	120
" lime	1.8	118
Coral	2.68	167
Crystal, rock	2.653	165
Diamond	3.536	221
Earth, vegetable	1.4	90
" loamy	1.6	100
" semi-fluid	1.7	110
Emerald, Peru	2.775	173
Emery	4	250
Feldspar	2.6	162
Flint	2.594	162
Freestone, hewn	2.2	140
Garnet, common	3.576	223
" precious	4.23	264
Glass, white flint	3	188
" plate	2.94	184
" crown	2.53	158
Granite, Aberdeen	2.625	164
" Cornish	2.662	166
" Egyptian	2.654	165
" Guernsey	3	185
Gravel, Thames	—	112
" coarse, with sand	—	120
Gypsum	2.28	140
Hornblende	3	187
Jargon, Ceylon	4.416	276

SPECIFIC GRAVITIES AND WEIGHTS.

STONES, EARTHS, &c.—*continued.*

	Specific gravity.	Weight of a cubic foot in lbs. avoir.
Kentish rag	2.66	166
Lime, ordinary quick (stone)	.85	53
" chalk, ground	.83	52
Limestone, lias	2 5	156
" magnesian	2.3	144
" Plymouth	2.67	167
" compact (mountain)	2.7	170
" Bermuda, soft	1.47	92
" " hard	2.62	164
Loadstone	4.93	308
Marble (average)	2.7	170
Marl	1.9	120
Masonry, rubble	2.2	140
" flint	2.3	148
" ashlar, Portland	2.2	140
" " Purbeck	2.3	150
" " granite	2.5	160
Mica	—	—
Millstone	2.5	155
Mortar, old	1.4	90
" new	1.7	110
Mud	1.63	102
Night soil	—	70
Opal	2.114	132
Pearl, oriental	2.684	167
Peat, hard	1.3	83
Pitch	1.1	72

SPECIFIC GRAVITIES AND WEIGHTS.

STONES, EARTHS, &c.—*continued.*

——	Specific gravity.	Weight of a cubic foot in lbs. avoir.
Plaster of Paris, cast	1.2	80
Porcelain, Chinese	2.385	147
" Limoges	2.341	146
Porphyry, green	2.9	180
" red	2.8	175
Portland stone	2	145
Pumice stone	.91	57
Purbeck stone	2.6	162
Puzzolana	2.7	170
Quartz	2.64	166
Rotten stone	2	124
Ruby, oriental	4.283	267
Sand, river	1.9	118
" Thames	1.6	103
" pit, clean, coarse	1.6	100
" " " fine	1.5	95
Sandstone, Craigleith	2.3	145
Sapphire, oriental	3.994	243
Shale	2.6	162
Shingle	—	95
Slate, Welsh	2.9	181
" " rag	2.7	172
" Anglesey	2.8	180
" Westmoreland	2.8	174
Slates, Cornish grey-blue	2.5	160
Spar	2.594	162
" heavy	4.43	276

SPECIFIC GRAVITIES AND WEIGHTS.

STONES, EARTHS, &c.—*concluded.*

	Specific Gravity.	Weight of a cubic foot in lbs. avoir.
Sulphur, melted	2	124
" native	2.033	127
Syenite	2.6	164
Thames ballast	—	112
Tiles, average	1.8	115
Topaz	3.8	237
Trap	2.7	172
Whinstone, Scotch	2.7	172
White lead	3.16	197
Yorkshire paving	2.5	156

LIGHTNING CONDUCTORS.

(British Government.)

Weight per foot run.

	lbs.
Copper rod, $\frac{1}{2}$-inch diameter	.757
" bar, $1\frac{1}{2}'' \times \frac{1}{8}''$	.723
" tube, $\frac{3}{8}''$ ext. diameter by $\frac{1}{8}''$ thick	.757
Iron rod, 1-inch diameter	2.645
" bar, $2'' \times \frac{3}{8}''$	2.526

The conductor should be connected to other metal work in the building.

At the base the conductor should have about 6 super. feet in contact with permanently wet soil.

SPECIFIC VOLUME AND WEIGHT OF DRY AIR

At different Temperatures, under a constant Atmospheric Pressure of 29.92 inches in the Barometer, the Volume at 32° Fahr. being the unit.

Temp. Fahr.	Volume.	Weight per cubic ft. pounds.	Temp. Fahr.	Volume.	Weight per cubic ft. pounds.
0°	.935	.0864	162°	1.265	.0638
12	.960	.0842	172	1.285	.0628
22	.980	.0824	182	1.306	.0618
32	1.000	.0807	192	1.326	.0609
42	1.020	.0791	202	1.347	.0600
52	1.041	.0776	212	1.367	.0591
62	1.061	.0761	230	1.404	.0575
72	1.082	.0747	250	1.444	.0559
82	1.102	.0733	275	1.495	.0540
92	1.122	.0720	300	1.546	.0522
102	1.143	.0707	325	1.597	.0506
112	1.163	.0694	350	1.648	.0490
122	1.184	.0682	375	1.689	.0477
132	1.204	.0671	400	1 750	.0461
142	1.224	.0659	450	1.852	.0436
152	1.245	.0649	500	1.954	.0413

RATIO OF MEAN AND SURFACE VELOCITIES OF RIVERS, ETC.

The maximum velocity is usually considered to be at the surface over the deepest part.

v = mean velocity.

V = maximum surface velocity.

u = velocity upon bed.

$v = V\frac{7.783+V}{10\ 345+V} = .83V$ approximately.

$u = 2v - V = .75v = .62V$ approximately.

In large rivers, however, Captain Humphreys and Lieut. Abbot found, from observations in the Mississippi, that the velocities at various depths vary as the abscissæ of a parabola whose axis is parallel to the water's surface and represents the maximum velocity, and is in calm weather, at a depth below the surface equal $\frac{8}{10}$ depth of water at section. This varies with the wind, but the mid-depth velocity does not vary, and is therefore the most convenient to observe. The mean velocity was found to increase gradually, and quite uniformly, from the banks to the thread of the current. The following equations represent the relation between the measured mid-depth velocity V_1 in any vertical plane, and the velocities in calm weather at other depths in the same plane.

Mean velocity $V_2 = V_1 - \frac{1}{12}\sqrt{bv}$

Maximum velocity $\left\{ V_2 = V_2 + \sqrt{bv}\left(\frac{1}{3} + \frac{d_1(d_1 - d')}{d^2}\right)\right.$

Surface velocity $V_0 = V_2 - \sqrt{bv}\left(\frac{d_1}{d}\right)^2$

Bottom velocity $V_4 = V_2 - \sqrt{bv}\left(1 - \frac{d_1}{d}\right)^2$

Where $b = .856$ for rivers having a depth $d = 30'$, $b = \frac{1.69}{\sqrt{d} + 1.5}$ for less values of d; $d_1 = .317d$ and is the depth of axis of parabola below surface; v is the approximate mean velocity of river, obtained by taking mean of observed velocities at mid-depth as the mean velocity of all the vertical planes; and V_1 is the mid-depth velocity.

They found the best way of obtaining the velocity was to suspend kegs without top or bottom, ballasted with strips of lead, by a rope to surface floats of light pine $5.5'' \times 5.5'' \times .5''$, or of tin of an ellipsoidal form with axes $5.5''$ and $1.5''$. The kegs were $9''$ in height, $6''$ diameter, with rope $\frac{1}{10}''$ in diameter for observations not more than $5'$ below surface, $12''$ in height, $8''$ diameter, with rope rather less than $\frac{3}{10}''$ diameter for deeper ones. The rope of such a length that kegs were at depth required to be observed. The observations were taken for a length of 200 feet.

Bazin found, mean velocity = surface velocity—$25.4\sqrt{\text{hydraulic mean depth}}$—hydraulic slope of stream.

The mean velocity may be found from slope of water surface, from Neville's formula—

$$V = 140\sqrt{rs} - 11\sqrt[3]{rs}$$

VELOCITY AND FORCE OF THE WIND.

VELOCITY.		Force on 1 Square Foot in Pounds Avoird'p's.	Character of the Wind.
Miles per Hour.	Feet per Second.		
1	1.47	.005	Hardly perceptible.
2	2.93	.020	Just perceptible.
3	4.40	.044	
4	5.87	.079	Gentle, pleasant wind.
5	7.33	.123	
6	8.80	.177	
7	10.27	.241	Moderate breeze.
8	11.73	.315	
9	13.20	.399	
10	14.67	.492	
11	16.13	.595	
12	17.60	.708	Pleasant, brisk gale.
13	19.07	.831	
14	20.53	.964	
15	22.00	1.107	
20	29.33	1.968	Very brisk.
25	36.67	3.075	
30	44.00	4.429	High winds.
35	51.33	6.027	
40	58.67	7 873	Very high.
45	66.00	9.963	
50	73.33	12.300	Storm or tempest.
55	80 67	14.883	
60	88 00	17.715	
65	95.33	20 787	Great storm.
70	102.67	24.108	

THE ANGLES WHICH EVERY POINT AND QUARTER-POINT OF THE COMPASS MAKES WITH THE MERIDIAN.

Points.	°	′	″	NORTH.	
0 ¼	2	48	45		
0 ½	5	37	30		
0 ¾	8	26	15		
1	11	15	0	N. by E.	N. by W.
1 ¼	14	3	45		
1 ½	16	52	30		
1 ¾	19	41	15		
2	22	30	0	N.N.E.	N.N.W.
2 ¼	25	18	45		
2 ½	28	7	30		
2 ¾	30	56	15		
3	33	45	0	N.E. by N.	N.W. by N.
3 ¼	36	33	45		
3 ½	39	22	30		
3 ¾	42	11	15		
4	45	0	0	N.E.	N.W.
4 ¼	47	48	45		
4 ½	50	37	30		
4 ¾	53	26	15		
5	56	15	0	N.E. by E.	N.W. by W.
5 ¼	59	3	45		
5 ½	61	52	30		
5 ¾	64	41	15		
6	67	30	0	E.N.E.	W.N.W.
6 ¼	70	18	45		
6 ½	73	7	30		
6 ¾	75	56	15		
7	78	45	0	E. by N.	W. by N.
7 ¼	81	33	45		
7 ½	84	22	30		
7 ¾	87	11	15		
8	90	0	0	East.	West.

THE ANGLES WHICH EVERY POINT AND QUARTER-POINT OF THE COMPASS MAKES WITH THE MERIDIAN.

Points.	°	′	″	SOUTH.	
0 ¼	2	48	45		
0 ½	5	37	30		
0 ¾	8	26	15		
1	11	15	0	S. by E.	S. by W.
1 ¼	14	3	45		
1 ½	16	52	30		
1 ¾	19	41	15		
2	22	30	0	S.S.E.	S.S.W.
2 ¼	25	18	45		
2 ½	28	7	30		
2 ¾	30	56	15		
3	33	45	0	S.E. by S.	S.W. by S.
3 ¼	36	33	45		
3 ½	39	22	30		
3 ¾	42	11	15		
4	45	0	0	S.E.	S.W.
4 ¼	47	48	45		
4 ½	50	37	30		
4 ¾	53	26	15		
5	56	15	0	S.E. by E.	S.W. by W.
5 ¼	59	3	45		
5 ½	61	52	30		
5 ¾	64	41	15		
6	67	30	0	E.S.E.	W.S.W.
6 ¼	70	18	45		
6 ½	73	7	30		
6 ¾	75	56	15		
7	78	45	0	E. by S.	W. by S.
7 ¼	81	33	45		
7 ½	84	22	30		
7 ¾	87	11	15		
8	90	0	0	East.	West.

SHOWING THE DIFFERENCE OF LEVEL.

Distance.	Difference of Level.	Distance.	Difference of Level.
Yards.	Inches.	Miles.	Ft. In.
100	0.026	$\frac{1}{4}$	0 $0\frac{1}{2}$
200	0.103	$\frac{1}{2}$	0 2
300	0.231	$\frac{3}{4}$	0 $4\frac{1}{2}$
400	0.411	1	0 8
500	0.643	2	2 8
600	0.925	3	6 0
700	1.200	4	10 7
800	1.645	5	16 7
900	2.081	6	23 11
1000	2.570	7	32 6
1100	3.110	8	42 6
1200	3.701	9	53 9
1300	4.344	10	66 4
1400	5.038	11	80 3
1500	5.784	12	95 7
1600	6.580	13	112 2
1700	7.425	14	130 1

USE OF THE ABOVE TABLE.—*First.* To find the height of the apparent level above the true.

Second. To find the extent of the visible horizon, or how far can be seen from any given height, on a horizontal plane, as at sea, etc. Suppose the eye of an observer on the top of a ship's mast, at sea, is at the height of 130 feet above the water, he will then see about 14 miles all around.

Third. Suppose a spring to be on one side of a hill, and a house on the opposite hill, with a valley between them, and that the spring, seen from the house, appears, by a leveling instrument, to be on a level with the foundation of the house, which, suppose, is at a mile distance from it—then is the spring eight inches above the true level of the house; and this difference would be barely sufficient for the water to be brought in pipes from the spring to the house; the pipes being laid all the way in the ground.

Lastly. If the height or distance exceeds the limits of the table, then first (if the distance be given), divide it by 2 or by 3, or by 4, etc., till the quotient comes within the distances in the table; then take the height answering to the quotient, and multiply it by the square of the divisor, that is, by 4 or 9, or 16 for the height required,

THE PRESSURE OF WATER AT DIFFERENT HEADS.

H=head in feet. P=pressure in lbs. per square foot
p=pressure in lbs. per square inch.

H	P	p	H	P	p
1	62.4	.4333	9	561.6	3 9
1.25	78	.5416	10	624	4.3333
1.5	93.6	.65	20	1248	8.6666
1.75	109.2	.7538	30	1872	13
2	124.8	.8666	40	2496	17.3333
3	187.2	1.3	50	3120	21.6666
4	249.6	1.7333	60	3744	26
5	312	2.1666	70	4368	30.3333
6	374.4	2.6	80	4992	34.6666
7	436.8	3.0333	90	5616	39
8	499.2	3.4666			

MEASUREMENT OF HEIGHTS BY THE BOILING POINT OF WATER.

TABLE I.—Showing the elevation and Barometric Pressure corresponding to any Temperature of the Vapor of Boiling Water, between 214° and 178° F., calculated for latitude 45°.

Boiling point Temperature.	Approximate Height above the Sea Level.	Difference for each Degree.	Corresponding Height of Barometer.
Deg.	Feet.	Feet.	Inches.
214	— 1032		31 125
213	— 517	515	30.519
212	0	517	29 922
211	+ 519	519	29.335
210	1041	522	28.756
209	1566	525	28.185
208	2094	527	27.623
207	2623	529	27.070
206	3154	531	26.527
205	3686	533	25.993
204	4221	535	25.468
203	4757	536	24 952
202	5295	538	24.445
201	5834	540	23.946
200	6376	542	23.456

TABLE I.—*continued.*

Boiling point Temperature.	Approximate Height above the Sea Level.	Difference for each Degree.	Corresponding Height of Barometer.
Deg.	Feet.	Feet.	Inches.
199	6919	543	22.974
198	7464	545	22.501
197	8011	547	22.036
196	8561	550	21.578
195	9112	551	21 129
194	9665	553	20.687
193	10220	555	20.254
192	10776	557	19.828
191	11335	559	19.409
190	11896	561	18.998
189	12459	563	18.594
188	13024	565	18.197
187	13591	567	17.807
186	14160	569	17.424
185	14731	571	17.049
184	15304	573	16.680
183	15879	575	16.318
182	16456	577	15.963
181	17035	579	15.614
180	17615	580	15.271
179	18197	582	14.934
178	18782	585	14.604

TABLE II.—Multipliers, for correcting the approximate Height for Mean Temperature of the Air.

Mean Temp.	Factor.	Mean Temp.	Factor.	Mean Temp.	Factor.
10°	.955	35°	1.006	60°	1.057
11	.957	36	1 008	61	1.059
12	.959	37	1.010	62	1.061
13	.961	38	1.012	63	1.064
14	.963	39	1.014	64	1.065
15	.965	40	1.016	65	1.067
16	.967	41	1.018	66	1.069
17	.970	42	1.020	67	1.071
18	.972	43	1.022	68	1.073
19	.974	44	1.024	69	1.075
20	.976	45	1.026	70	1.077
21	.978	46	1.029	71	1.079
22	.980	47	1.031	72	1.082
23	.982	48	1.033	73	1.084
24	.984	49	1.035	74	1.086
25	.986	50	1.037	75	1.088
26	.988	51	1.039	76	1.090
27	.990	52	1.041	77	1.092
28	.992	53	1.043	78	1.094
29	.994	54	1.045	79	1.096
30	.996	55	1 047	80	1.098
31	.998	56	1.049	81	1.100
32	1.000	57	1.051	82	1.102
33	1.102	58	1.053	83	1.104
34	1.104	59	1.055	84	1.106

TABLE III.—Correction to be added to the calculated Height, on account of the decrease of gravity above the sea level.

Height in thousand feet.	Correction additive.	Height in thousand feet.	Correction additive.
	Feet.		Feet.
1	3	10	30
2	5	11	33
3	8	12	37
4	11	13	41
5	14	14	44
6	17	15	48
7	20	16	52
8	23	17	56
9	26	18	60

TO USE THE TABLES.

1st. From Table I. take out the approximate height due to the boiling points at the upper and lower stations respectively.

2d. Multiply the difference, between these approximate heights, by the factor found in Table II. corresponding to the mean of the temperatures of the air at the two stations.

3d. Add the correction found in Table III.

EXAMPLE.

At Upper Station, boiling point 188°.3; air 43°
" Lower " " " 206°.5; " 65°

	Feet.	
188° in Table I. give	13024	
.3 " " "	169	
	12855.....	12855
206° " " "	3154	
.5 " " "	265	
	2889.....	2889
		9966
Mean Tem. $\frac{65+43}{2}$ = 54 in Table II. gives		1.045
		49830
		39864
		9966
		10414.470
Table III. gives.....		+30
Height in feet, between the Stations.....		10444

NOTE.—If a barometer be used at one Station, and the latitude differs much from 45°, its reading, reduced to 32° F., should be multiplied by the factor corresponding to the latitude, as given in the annexed Table. Then use the barometric pressure thus modified with

the preceding tables to obtain the corresponding boiling point.

Latitude.	Factor.	Latitude.	Factor.
0°	0.99735	45	1.00000
5	0.99739	50	1.00046
10	0.99751	55	1.00090
15	0.99770	60	1.00132
20	0.99797	65	1.00170
25	0.99830	70	1.00203
30	0.99868	75	1.00230
35	0.99910	80	1.00249
40	0.99954		

As an example, suppose that a series of observations made on a tropical mountain give a mean boiling point for water of 185°, and that the mean height of the barometer reduced to 32° F., at the nearest observatory in the adjacent country, be 29.72 inches; assuming also that the temperature of the air at the upper station is 36°, and at the lower 80°, and that the latitude of the observatory is 12°; what is the probable difference of height?

For lat. 12°, the factor is 0.99759

$29.72 \times .99759 = 29.648$

29.648 in Table I. gives 211.53, and..... 244 ft.
185° " " " " .....14731 "

Difference	14487
Mean Temp. $\frac{36+80}{2}$ =58 give in Table II.	1.053
	15255
Cor. from Table III.	+48
Difference of height,	15303

EXAMPLES FOR PRACTICE.

1. On the Matterhorn the boiling-point was 192°.54, air 12°; at St. Bernard, 8,180 feet above the sea, the barometer at 32° F. was 22.446 inches, air 43°. Find the height of the upper station.

Height, 11,133 feet.

2. On the Col d'Auterne the boiling-point was 199°; assume the mean temperature of the air 62°, and find the height.

Height 7,361 feet.

3. On the Chamouni the boiling-point was 197°; assume the mean temperature 62°, and find the height.

Height, 8,525 feet.

In TABLE I. the heights in feet have been computed from the formula*—Height=60300 (log. 29.922—log. V.); V being the vapor tension corresponding to the boiling-point of pure water, according to Regnault, as given in the fourth column, which is taken from the extensive table of vapor tensions in that valuable manual, Sir H. James' "*Instructions for Meteorological Observations.*" This fourth column will serve to convert barometric observations, when reduced to 32° F., to the equivalent boiling-point temperature; and will be useful when a barometer has been employed at one of the stations of observation, as well as for the purpose of comparison when the barometer and hypsometer are used together, and where this can be done at considerable altitudes, say above 5000 feet, the observations would be of much scientific value.

*Vide Sir J. Herschel's "*Meteorology.*"

TABLE II. is for the purpose of correcting the height obtained by TABLE I. on account of the mean temperature of the air, as TABLE I. only applies to air at the temperature of freezing water. It has been calculated from the coefficient for the expansion of air, viz., .0020404 of its bulk at 32° for each degree above that temperature, as determined by the late experiments made for the Royal Society by Balfour Stewart, F.R.S., Director of the Kew Observatory, and which differs very slightly from that ascertained by Regnault.

TABLE III. is a small correction to be added to the height, and depends upon the decrease of gravity for elevation above the sea-level.

THE LENGTH OF CIRCULAR ARCS, RADIUS BEING UNITY.

Deg.	Length.	Deg.	Length.	Min.	Length.	Sec.	Length.
1	0.0174533	60	1.0471976	1	0.0002909	1	0.000048
2	0.0349066	70	1.2217305	2	0.0005818	2	0.000097
3	0.0523599	80	1.3962634	3	0.0008727	3	0.0000145
4	0.0698132	90	1.5707963	4	0.0011636	4	0.0000194
5	0.0872665	100	1.7453293	5	0.0014544	5	0.0000242
6	0.1047198	120	2.0943951	6	0.0017453	6	0.0000291
7	0.1221730	150	2.6179939	7	0.0020362	7	0.0000339
8	0.1396263	180	3.1415927	8	0.0023271	8	0.0000388
9	0.1570796	210	3.6651914	9	0.0026180	9	0.0000436
10	0.1745329	240	4.1887902	10	0.0029089	10	0.0000485
20	0.3490659	270	4.7123890	20	0.0058178	20	0.0000970
30	0.5235988	300	5.2359878	30	0.0087266	30	0.0001454
40	0.6981317	330	5.7595865	40	0.0116355	40	0.0001939
50	0.8726646	360	6.2831853	50	0.0145444	50	0.0002424

MEASUREMENT OF HEIGHTS BY BAROMETER.

Read the barometer, and, if possible, a small thermometer whirled rapidly through the air (*thermometre fronde*) at the lower station, do the same at the upper one, and do it again at the lower one, on your return. Let the readings be—

10 a. m.	lower station,	barometer	30.22,	temp.	46°
noon	upper "	"	29.14,	"	41°
2 p. m.	lower "	"	30.20,	"	54°

The above are all the readings necessary.

The calculations are as follows :

(1) Take the mean of the two observations at the lower station ; this will probably fairly represent the pressure and temperature at the lower station when the observation was made at the upper one.

	At lower station.	
10 a. m.....	30.22	46°
2 p. m.....	30.20	54°
	2)60.42	2)100

Mean pressure 30.21 50° mean temp.

(2) Ascertain the mean pressure and mean temperature at the two stations.

	Pressure.	Temp.
Mean at lower station.....	30.21	50°
Observation at upper station..	29.14	44
	2)59.35	2)94
Mean at both stations..	29.675	47°

(3) Look in the general table for the multiplier corresponding to the mean pressure (29.675) and mean temperature (47), viz., 9.14, and multiply the difference of the two pressures by it.

Lower station.....	30.21
Upper "	29.14
	107
	9.14
	428
	107
	963
	977.98

Reject the last two figures, and the result will be the height in feet. In the above example the rejected figures are so large that the altitude should be considered as 978 rather than 977.

The foregoing remarks have not specified the form of instrument employed, because they are equally applicable to all varieties.

For a compensated aneroid they are correct as they stand. If a mercurial barometer be used, the readings need only be reduced to 32° in the usual manner, and the results so reduced will be ready for treatment precisely as if they were aneroid readings.

MEAN BAROMETRIC PRESSURE.

Temp.	22.0	22.1	22.2	22.3	22.4
30	11.90	11.85	11.79	11.73	11.68
32	11.95	11.90	11.84	11.78	11.73
34	12.00	11.95	11.89	11.83	11.78
36	12.05	12.00	11.94	11.88	11.83
38	12.10	12.05	11.99	11.93	11.88
40	12.15	12.10	12.04	11.98	11.93
42	12.21	12.15	12.09	12.03	11.98
44	12.26	12.21	12.15	12.09	12.04
46	12.32	12.27	12.21	12.15	12.09
48	12.37	12.32	12.26	12.20	12.14
50	12.42	12.37	12.31	12.25	12.19
52	12.47	12.42	12.36	12.30	12.24
54	12.53	12.48	12.42	12.36	12.30
56	12.58	12.53	12.47	12.42	12.36
58	12.63	12.58	12.52	12.47	12.41
60	12.68	12.63	12.57	12.52	12.46
62	12.74	12.69	12.63	12.58	12.52
64	12.79	12.74	12.68	12.63	12.57
66	12.84	12.79	12.73	12.68	12.62
68	12.89	12.84	12.78	12.73	12.67
70	12.95	12.89	12.83	12.78	12.72
72	13.00	12.94	12.88	12.83	12.77
74	13.05	12.99	12.93	12.88	12.82
76	13.10	13.04	12.98	12.93	12.87
78	13.16	13.10	13.04	12.99	12.93
80	13.21	13.15	13.09	13.04	12.98

MEAN BAROMETRIC PRESSURE.

Temp.	22.5	22.6	22.7	22.8	22.9
30	11.62	11.57	11.52	11.47	11.42
32	11.67	11.62	11.57	11.52	11.47
34	11.72	11.67	11.62	11.57	11.52
36	11.78	11.72	11.67	11.62	11.57
38	11.83	11.77	11.72	11.67	11.62
40	11.88	11.82	11.77	11.72	11.67
42	11.93	11.87	11.82	11.77	11.72
44	11.99	11.93	11.88	11.83	11.78
46	12.04	11.98	11.93	11.88	11.83
48	12.09	12.03	11.98	11.93	11.88
50	12.14	12.08	12.03	11.98	11.93
52	12.19	12.13	12.08	12.03	11.98
54	12.25	12.19	12.14	12.08	12.03
56	12.30	12.24	12.19	12.13	12.08
58	12.35	12.29	12.24	12.18	12.13
60	12.40	12.34	12.29	12.23	12.18
62	12.46	12.40	12.35	12.29	12.24
64	12.51	12.46	12.40	12.34	12.29
66	12.56	12.50	12.45	12.39	12.34
68	12.61	12.55	12.50	12.44	12.39
70	12.66	12.60	12.55	12.49	12.44
72	12.71	12.65	12.60	12.54	12.49
74	12.76	12.70	12.65	12.59	12.54
76	12.81	12.75	12.70	12.64	12.59
78	12.87	12.81	12.75	12.70	12.64
80	12.92	12.86	12.81	12.75	12.70

MEAN BAROMETRIC PRESSURE.

Temp.	23.0	23.1	23.2	23.3	23.4
30	11.37	11.32	11.27	11.22	11.17
32	11.42	11.37	11.32	11.27	11.22
34	11.47	11.42	11.37	11.32	11.27
36	11.52	11.47	11.42	11.37	11.32
38	11.57	11.52	11.47	11.42	11.37
40	11.62	11.57	11.52	11.47	11.42
42	11.67	11.62	11.57	11.52	11.47
44	11.72	11.67	11.62	11.57	11.52
46	11.77	11.72	11.67	11.62	11.57
48	11.82	11.77	11.72	11.67	11.62
50	11.87	11.82	11.77	11.72	11.67
52	11.92	11.87	11.82	11.77	11.72
54	11.98	11.93	11.87	11.82	11.77
56	12.03	11.98	11.92	11.87	11.82
58	12.08	12.03	11.97	11.92	11.87
60	12.13	12.08	12.02	11.97	11.92
62	12.18	12.13	12.07	12.02	11.97
64	12 23	12.18	12.12	12.07	12.02
66	12.28	12.23	12.17	12.12	12.07
68	12.33	12.28	12 22	12.17	12.12
70	12.38	12.33	12.27	12.22	12.17
72	12.43	12.38	12.32	12.27	12.22
74	12.48	12.43	12.37	12.32	12.27
76	12.53	12.48	12.42	12.37	12.32
78	12.58	12.53	12.48	12.43	12.37
80	12.64	12.59	12.53	12.48	12.42

MEAN BAROMETRIC PRESSURE.

Temp.	23.5	23.6	23.7	23.8	23.9
30	11.12	11.08	11.04	10.99	10.95
32	11.17	11.13	11.09	11.04	11.00
34	11.22	11.18	11.14	11.09	11.05
36	11.27	11.22	11.18	11.13	11.09
38	11.32	11.27	11.23	11.19	11.14
40	11.37	11.32	11.28	11.23	11.19
42	11.42	11.37	11.33	11.28	11.24
44	11.47	11.42	11.38	11.33	11.29
46	11.52	11.47	11.43	11.38	11.33
48	11.57	11.52	11.48	11.43	11.38
50	11.62	11.57	11.53	11.48	11.43
52	11.67	11.62	11.58	11.53	11.48
54	11.72	11.67	11.63	11.58	11.53
56	11.77	11.72	11.68	11.63	11.58
58	11.82	11.77	11.73	11.68	11.63
60	11.87	11.82	11.77	11.72	11.67
62	11.92	11.87	11.82	11.77	11.72
64	11.97	11.92	11.87	11.82	11.77
66	12.02	11.97	11.92	11.87	11.82
68	12.07	12.02	11.97	11.92	11.87
70	12.12	12.07	12.02	11.97	11.92
72	12.17	12.12	12.07	12.02	11.97
74	12.22	12.17	12.12	12.07	12.02
76	12.27	12.22	12.17	12.12	12.07
78	12.32	12.27	12.22	12.16	12.11
80	12.37	12.32	12.26	12.21	12.16

MEAN BAROMETRIC PRESSURE.

Temp.	24.0	24.1	24.2	24.3	24.4
30	10.90	10.85	10.81	10.76	10.71
32	10.95	10.90	10.86	10.81	10.76
34	11.00	10.95	10.91	10.86	10.81
36	11.04	10.99	10.95	10.90	10.85
38	11.09	11.04	10.99	10.95	10.90
40	11.14	11.09	11.05	11.00	10.95
42	11.19	11.14	11.10	11.05	11.00
44	11.24	11.19	11.14	11.09	11.04
46	11.28	11.23	11.19	11.14	11.09
48	11.33	11.28	11.24	11.19	11.14
50	11.38	11.33	11.29	11.24	11.19
52	11.43	11.38	11.34	11.29	11.24
54	11.48	11.43	11.38	11.33	11.28
56	11.53	11.48	11.43	11.38	11.33
58	11.58	11.53	11.48	11.43	11.38
60	11.62	11.58	11.53	11.48	11.43
62	11.67	11.63	11.58	11.53	11.48
64	11.72	11.67	11.62	11.58	11.53
66	11.77	11.72	11.67	11.62	11.57
68	11.82	11.77	11.72	11.67	11.62
70	11.87	11.82	11.77	11.72	11.67
72	11.92	11.87	11.82	11.77	11.72
74	11.97	11.92	11.87	11.82	11.77
76	12.02	11.97	11.92	11.87	11.82
78	12.07	12.02	11.97	11.92	11.87
80	12.11	12.06	12.01	11.96	11.91

MEAN BAROMETRIC PRESSURE.

Temp.	24.5	24.6	24.7	24.8	24.9
30	10.67	10.63	10.59	10.55	10.51
32	10.72	10.68	10.64	10.60	10.56
34	10.77	10.73	10.69	10.65	10.61
36	10.81	10.77	10.73	10.69	10.65
38	10.85	10.81	10.77	10.73	10.69
40	10.90	10.86	10.82	10.78	10.74
42	10.95	10.91	10.87	10.83	10.79
44	10.99	10.95	10.91	10.87	10.83
46	11.04	11.00	10.96	10.91	10.87
48	11.09	11.05	11.01	10.96	10.92
50	11.14	11.10	11.06	11.01	10.97
52	11.19	11.15	11.11	11.06	11.02
54	11.24	11.19	11.15	11.11	11.07
56	11.29	11.24	11.20	11.15	11.11
58	11.34	11.29	11.25	11.20	11.16
60	11.39	11.34	11.30	11.25	11.21
62	11.44	11.39	11.35	11.30	11.26
64	11.49	11.44	11.40	11.35	11.31
66	11.53	11.49	11.44	11.39	11.35
68	11.58	11.53	11.49	11.44	11.40
70	11.63	11.58	11.53	11.48	11.44
72	11.67	11.62	11.58	11.53	11.49
74	11.72	11.67	11.63	11.58	11.54
76	11.77	11.72	11.68	11.63	11.58
78	11.82	11.77	11.73	11.68	11.63
80	11.86	11.81	11.77	11.72	11.67

MEAN BAROMETRIC PRESSURE.

Temp.	25.0	25.1	25.2	25.3	25.4
30	10.46	10.42	10.38	10.34	10.30
32	10.51	10.47	10.43	10.39	10.35
34	10.56	10.52	10.47	10.43	10.39
36	10.61	10.57	10.52	10.48	10.44
38	10.65	10.61	10.56	10.52	10.48
40	10.69	10.65	10.60	10.56	10.52
42	10.74	10.70	10.65	10.61	10.57
44	10.78	10.74	10.70	10.66	10.62
46	10.82	10.78	10.74	10.70	10.66
48	10.87	10.83	10.79	10.75	10.70
50	10.92	10.88	10.84	10.80	10.75
52	10.97	10.93	10.89	10.85	10.80
54	11.02	10.98	10.93	10.89	10.84
56	11.06	11.02	10.98	10.94	10.89
58	11.11	11.07	11.03	10.99	10.94
60	11.16	11.12	11.07	11.03	10.98
62	11.21	11.17	11.12	11.08	11.03
64	11.26	11.22	11.17	11.13	11.08
66	11.30	11.26	11.21	11.17	11.12
68	11.35	11.31	11.26	11.22	11.17
70	11.39	11.35	11.30	11.26	11.21
72	11.44	11.40	11.35	11.31	11.26
74	11.49	11.45	11.40	11.36	11.31
76	11.53	11.49	11.44	11.40	11.35
78	11.58	11.54	11.49	11.45	11.40
80	11.62	11.58	11.53	11.49	11.44

MEAN BAROMETRIC PRESSURE.

Temp.	25.5	25.6	25.7	25.8	25.9
30	10.26	10.22	10.18	10.14	10.10
32	10.31	10.27	10.23	10.19	10.15
34	10.35	10.31	10.27	10.23	10.19
36	10.40	10.36	10.32	10.28	10.24
38	10.44	10.40	10.36	10.32	10.28
40	10.48	10 44	10.40	10.36	10.32
42	10.53	10.49	10.45	10.41	10.37
44	10.58	10.54	10.50	10.45	10.41
46	10.62	10.58	10.54	10.49	10.45
48	10.66	10.62	10.58	10.53	10.49
50	10.71	10.67	10.63	10.58	10.54
52	10.76	10.71	10.67	10.63	10.59
54	10.80	10.75	10.71	10.67	10.63
56	10.85	10.80	10.76	10.72	10.68
58	10.89	10.84	10.80	10.76	10.72
60	10.94	10.89	10.85	10.81	10.77
62	10.99	10.94	10.90	10.86	10.82
64	11 04	10.99	10.95	10.91	10.87
66	11.08	11.03	10.99	10.95	10.91
68	11.13	11.08	11 04	11.00	10.96
70	11.17	11.12	11.08	11.04	11.00
72	11.22	11.17	11.13	11.09	11.05
74	11.27	11.22	11.18	11.13	11.09
76	11.31	11.26	11.22	11.17	11.13
78	11.36	11.31	11.27	11.22	11.18
80	11.40	11.35	11.31	11.26	11.22

MEAN BAROMETRIC PRESSURE.

Temp.	26.0	26.1	26.2	26.3	26.4
30	10.06	10.02	9.98	9.94	9.90
32	10.11	10.07	10.03	9.99	9.95
34	10.15	10.11	10.07	10.03	9.99
36	10.20	10.16	10.12	10.08	10.04
38	10.24	10.20	10.16	10.12	10.08
40	10.28	10.24	10.20	10.16	10.12
42	10.33	10.29	10.25	10.21	10.17
44	10.37	10.33	10.29	10.25	10.21
46	10.41	10.37	10.33	10.29	10.25
48	10.45	10.41	10.37	10.33	10.29
50	10.50	10.46	10.42	10.38	10.34
52	10.55	10.51	10.47	10.43	10.39
54	10.59	10.55	10.51	10.47	10.43
56	10.64	10.60	10.56	10.52	10.48
58	10.68	10.64	10.60	10.56	10.52
60	10.73	10.69	10.65	10.61	10.57
62	10.77	10.73	10.69	10.65	10.61
64	10.82	10.78	10.74	10.70	10.66
66	10.86	10.82	10.78	10.74	10.70
68	10.91	10.87	10.83	10.79	10.75
70	10.95	10.91	10.87	10.83	10.79
72	11.00	10.96	10.92	10.88	10.84
74	11.05	11.01	10.97	10.93	10.89
76	11.09	11.05	11.01	10.97	10.93
78	11.14	11.10	11.05	11.01	10.97
80	11.18	11.14	11.09	11.05	11.01

MEAN BAROMETRIC PRESSURE.

Temp.	26.5	26.6	26.7	26.8	26.9
30	9.87	9.83	9.79	9.75	9.72
32	9.92	9.88	9.84	9.80	9.77
34	9.96	9.92	9.88	9.84	9.81
36	10.01	9.97	9.93	9.89	9.86
38	10.05	10.01	9.97	9.93	9.90
40	10.09	10.05	10.01	9.97	9.94
42	10.14	10.10	10.06	10.02	9.99
44	10.18	10.14	10.10	10.06	10.03
46	10.22	10.18	10.14	10.10	10.07
48	10.26	10.22	10.18	10.14	10.11
50	10.31	10.27	10.23	10.19	10.16
52	10.35	10.31	10.27	10.23	10.20
54	10.39	10.35	10.31	10.27	10.24
56	10.44	10.40	10.36	10.32	10.29
58	10.48	10.44	10.40	10.36	10.33
60	10.53	10.49	10.45	10.41	10.37
62	10.57	10.53	10.49	10.45	10.41
64	10.62	10.58	10.54	10.50	10.46
66	10.66	10.62	10.58	10.54	10.50
68	10.71	10.67	10.63	10.59	10.55
70	10.75	10.71	10.67	10.63	10.59
72	10.80	10.76	10.72	10.68	10.64
74	10.85	10.81	10.77	10.73	10.69
76	10.89	10.85	10.81	10.77	10.73
78	10.93	10.89	10.85	10.81	10.77
80	10.97	10.93	10.89	10.85	10.81

MEAN BAROMETRIC PRESSURE.

Temp.	27.0	27.1	27.2	27.3	27.4
30	9.68	9.65	9.61	9.58	9.54
32	9.73	9.70	9.66	9.63	9.59
34	9.77	9.74	9.70	9.67	9.63
36	9.82	9.79	9.75	9.71	9.67
38	9.86	9.83	9.79	9.75	9.71
40	9.90	9.87	9.83	9.79	9.75
42	9.95	9.92	9.88	9.84	9.80
44	9.99	9.96	9.92	9.88	9.84
46	10.03	10.00	9.96	9.92	9.88
48	10.07	10.04	10.00	9.97	9.93
50	10.12	10.08	10.04	10.01	9.97
52	10.16	10.12	10.08	10.05	10.01
54	10.20	10.16	10.12	10.09	10.05
56	10.25	10.21	10.17	10.13	10.09
58	10.29	10.26	10.22	10.18	10.14
60	10.33	10.30	10.26	10.22	10.18
62	10.37	10.34	10.30	10.26	10.22
64	10.42	10.38	10.34	10.30	10.26
66	10.46	10.42	10.38	10.34	10.30
68	10.51	10.47	10.43	10.39	10.35
70	10.55	10.51	10.47	10.43	11.39
72	10.60	10.56	10.52	10.48	10.44
74	10.64	10.60	10.56	10.52	10.48
76	10.68	10.64	10.60	10.57	10.53
78	10.72	10.68	10.64	10.61	10.57
80	10.76	10.72	10.68	10.65	10.61

MEAN BAROMETRIC PRESSURE.

Temp.	27.5	27.6	27.7	27.8	27.9
30	9.51	9.47	9.44	9.40	9.37
32	9.56	9.52	9.49	9.45	9.42
34	9.60	9.56	9.53	9.49	9.46
36	9.64	9.60	9.57	9.53	9.50
38	9.68	9.64	9.61	9.57	9.54
40	9.72	9.68	9.65	9.61	9.58
42	9.77	9.73	9.70	9.66	9.63
44	9.81	9.77	9.74	9.70	9.67
46	9.85	9.81	9.78	9.74	9.71
48	9.89	9.85	9.82	9.78	9.75
50	9.93	9.89	9.86	9.82	9.79
52	9.98	9.94	9.90	9.86	9.83
54	10.02	9.98	9.94	9.90	9.87
56	10.06	10.02	9.98	9.94	9.91
58	10.11	10.07	10.03	9.99	9.96
60	10.15	10.11	10.07	10.03	10.00
62	10.19	10.15	10.11	10.07	10.04
64	10.23	10.19	10.15	10.11	10.08
66	10.27	10.23	10.19	10.15	10.12
68	10.32	10.27	10.23	10.19	10.16
70	10.36	10.32	10.28	10.24	10.21
72	10.40	10.36	10.32	10.28	10.25
74	10.44	10.40	10.36	10.32	10.29
76	10.49	10.45	10.41	10.37	10.33
78	10.53	10.49	10.45	10.41	10.37
80	10.57	10.53	10.49	10.45	10.42

MEAN BAROMETRIC PRESSURE.

Temp.	28.0	28.1	28.2	28.3	28.4
30	9.33	9.30	9.27	9.24	9.20
32	9.38	9.35	9.32	9.29	9.25
34	9.42	9.39	9.36	9.33	9.29
36	9.46	9.43	9.40	9.37	9.33
38	9.50	9.47	9.44	9.41	9.37
40	9.54	9.51	9.48	9.45	9.41
42	9.59	9.56	9.52	9.49	9.45
44	9.63	9.60	9.56	9.53	9.49
46	9.67	9.64	9.60	9.57	9.53
48	9.71	9.68	9.64	9.61	9.57
50	9.75	9.72	9.68	9.65	9.61
52	9.79	9.76	9.72	9.69	9.65
54	9.83	9.80	9.76	9.73	9.69
56	9.87	9.84	9.80	9.77	9.73
58	9.92	9.89	9.85	9.82	9.78
60	9.96	9.93	9.89	9.86	9.82
62	10.00	9.97	9.93	9.90	9.86
64	10.04	10.01	9.97	9.94	9.90
66	10.08	10.05	10.01	9.98	9.94
68	10.12	10.09	10.05	10.02	9.98
70	10.17	10.14	10.10	10.06	10.02
72	10.21	10.18	10.14	10.10	10.06
74	10.25	10.22	10.18	10.14	10.10
76	10.29	10.26	10.22	10.18	10.14
78	10.33	10.30	10.26	10.22	10.18
80	10.38	10.34	10.30	10.27	10.23

MEAN BAROMETRIC PRESSURE.

Temp.	28.5	28.6	28.7	28.8	28.9
30	9.17	9.13	9.10	9.07	9.04
32	9.22	9.18	9.15	9.12	9.09
34	9.26	9.22	9.19	9.16	9.13
36	9.30	9.26	9.23	9.20	9.17
38	9.34	9.30	9.27	9.24	9.21
40	9.38	9.34	9.31	9.28	9.25
42	9.42	9.38	9.35	9.32	9.29
44	9.46	9.42	9.39	9.36	9.33
46	9.50	9.46	9.43	9.40	9.37
48	9.54	9.50	9.47	9.44	9.41
50	9.58	9.55	9.52	9.48	9.45
52	9.62	9.59	9.56	9.52	9.49
54	9.66	9.63	9.60	9.56	9.53
56	9.70	9.67	9.64	9.60	9.57
58	9.75	9.71	9.68	9.64	9.61
60	9.79	9.75	9.72	9.68	9.65
62	9.83	9.79	9.76	9.72	9.69
64	9.87	9.83	9.80	9.76	9.73
66	9.91	9.87	9.84	9.80	9.77
68	9.95	9.91	9.88	9.84	9.81
70	9.99	9.95	9.92	9.88	9.85
72	10.03	9.99	9.96	9.92	9.89
74	10.07	10.03	10.00	9.96	9.93
76	10.11	10.07	10.04	10.00	9.97
78	10.15	10.11	10.08	10.04	10.01
80	10.20	10.16	10.13	10.09	10.06

MEAN BAROMETRIC PRESSURE.

Temp.	29.0	29.1	29.2	29.3	29.4
30	9.00	8.98	8.95	8.92	8.89
32	9.05	9.02	8.99	8.96	8.93
34	9.09	9.06	9.03	9.00	8.97
36	9.13	9.10	9.07	9.04	9.01
38	9.17	9.14	9.11	9.08	9.05
40	9.21	9.18	9.15	9.12	9.09
42	9.25	9.22	9.19	9.16	9.13
44	9.29	9.26	9.23	9.20	9.17
46	9.33	9.30	9.27	9.24	9.21
48	9.37	9.34	9.31	9.28	9.25
50	9.41	9.38	9.35	9.32	9.29
52	9.45	9.42	9.39	9.36	9.33
54	9.49	9.46	9.43	9.40	9.37
56	9.53	9.50	9.47	9.44	9.41
58	9.58	9.55	9.51	9.48	9.45
60	9.62	9.59	9.55	9.52	9.48
62	9.66	9.63	9.59	9.56	9.52
64	9.70	9.67	9.63	9.60	9.56
66	9.74	9.71	9.67	9.64	9.60
68	9.78	9.75	9.71	9.68	9.64
70	9.82	9.79	9.75	9.72	9.68
72	9.86	9.83	9.79	9.76	9.72
74	9.90	9.87	9.83	9.80	9.76
76	9.94	9.91	9.87	9.84	9.80
78	9.98	9.95	9.91	9.88	9.84
80	10.02	9.99	9.95	9.92	9.88

MEAN BAROMETRIC PRESSURE.

Temp.	29.5	29.6	29.7	29.8	29.9
30	8.86	8.83	8.81	8.78	8.75
32	8.90	8.87	8.84	8.81	8.78
34	8.94	8.91	8.88	8.85	8.82
36	8.98	8.95	8.92	8.89	8.86
38	9.02	8.99	8.96	8.93	8.90
40	9.06	9.03	9.00	8.97	8.94
42	9.10	9.07	9.04	9.01	8.98
44	9.14	9.11	9.08	9.05	9.02
46	9.18	9.14	9.11	9.08	9.05
48	9.22	9.18	9.15	9.12	9.09
50	9.26	9.22	9.19	9.16	9.13
52	9.30	9.26	9.23	9.20	9.17
54	9.34	9.30	9.27	9.24	9.21
56	9.38	9.34	9.31	9.28	9.25
58	9.42	9.38	9.35	9.32	9.28
60	9.45	9.42	9.39	9.36	9.32
62	9.49	9.46	9.43	9.40	9.36
64	9.53	9.50	9.47	9.44	9.40
66	9.57	9.54	9.51	9.48	9.44
68	9.61	9.58	9.55	9.52	9.48
70	9.65	9.62	9.59	9.55	9.52
72	9.69	9.66	9.63	9.59	9.55
74	9.73	9.70	9.67	9.63	9.59
76	9.77	9.74	9.71	9.67	9.63
78	9.81	9.78	9.75	9.71	9.67
80	9.85	9.82	9.79	9.75	9.71

MEAN BAROMETRIC PRESSURE.

Temp.	30.0	30.1	30.2	30.3	30.4
30	8.72	8.69	8.66	8.63	8.60
32	8.75	8.72	8.69	8.66	8.63
34	8.79	8.76	8.73	8.70	8.67
36	8.83	8.80	8.77	8.74	8.71
38	8.87	8.84	8.81	8.78	8.75
40	8.91	8.88	8.85	8.82	8.79
42	8.95	8.92	8.89	8.86	8.83
44	8.99	8.96	8.93	8.90	8.87
46	9.02	8.99	8.96	8.93	8.90
48	9.06	9.03	9.00	8.97	8.94
50	9.10	9.07	9.04	9.01	8.98
52	9.14	9.11	9.08	9.05	9.02
54	9.18	9.15	9.12	9.09	9.06
56	9.22	9.19	9.16	9.13	9.10
58	9.25	9.22	9.19	9.16	9.13
60	9.29	9.26	9.23	9.20	9.17
62	9.33	9.30	9.27	9.24	9.21
64	9.37	9.34	9.31	9.28	9.25
66	9.41	9.38	9.35	9.32	9.29
68	9.45	9.42	9.39	9.36	9.33
70	9.49	9.46	9.43	9.39	9.36
72	9.52	9.49	9.46	9.43	9.40
74	9.56	9.53	9.50	9.47	9.44
76	9.60	9.57	9.54	9.51	9.48
78	9.64	9.61	9.58	9.55	9.52
80	9.68	9.65	9.62	9.59	9.56

MEAN BAROMETRIC PRESSURE.

Temp.	30.5	30.6	30.7	30.8	30.9
30	8.57	8.54	8.51	8.48	8.45
32	8.60	8.57	8.54	8.51	8.48
34	8.64	8.61	8.58	8.55	8.52
36	8.68	8.65	8.62	8.59	8.56
38	8.72	8.69	8.66	8.63	8.60
40	8.76	8.73	8.70	8.67	8.64
42	8.80	8.77	8.74	8.71	8.68
44	8.84	8.81	8.78	8.75	8.72
46	8.87	8.84	8.81	8.78	8.75
48	8.91	8.88	8.85	8.82	8.79
50	8.95	8.92	8.89	8.86	8.83
52	8.99	8.96	8.93	8.90	8.87
54	9.03	9.00	8.97	8.94	8.91
56	9.07	9.04	9.01	8.98	8.95
58	9.10	9.07	9.04	9.01	8.98
60	9.14	9.11	9.08	9.05	9.02
62	9.18	9.15	9.12	9.09	9.06
64	9.22	9.19	9.16	9.13	9.10
66	9.26	9.23	9.20	9.17	9.14
68	9.30	9.27	9.24	9.21	9.18
70	9.33	9.30	9.27	9.24	9.21
72	9.37	9.34	9.31	9.28	9.25
74	9.41	9.38	9.35	9.32	9.29
76	9.45	9.42	9.39	9.36	9.33
78	9.49	9.46	9.43	9.40	9.37
80	9.53	9.50	9.47	9.44	9.41

A COMPARISON OF WIRE GAUGES.

	B. W. G.	Washburn & Moen Wire Gauge.	Brown & Sharpe Wire Gauge.	New British Standard.
4–0	.454	.393	.460	.400
3–0	.425	.362	.409	.372
2–0	.380	.331	.364	.348
0	.340	.307	.324	.324
1	.300	.283	.289	.300
2	.284	.263	.257	.276
3	.259	.244	.229	.252
4	.238	.225	.204	.232
5	.220	.207	.181	.212
6	.203	.192	.162	.192
7	.180	.177	.144	.176
8	.165	.162	.128	.160
9	.148	.148	.114	.144
10	.134	.135	.101	.128
11	.120	.120	.090	.116
12	.109	.105	.080	.104
13	.095	.092	.072	.092
14	.083	.080	.064	.080
15	.072	.072	.057	.072
16	.065	.063	.050	.064

RAILWAY CURVES.

Radii, Degrees of Curvature, and Chord Ordinates and Deflections.

Degree.	Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
		25.	50.		18.	20.
° ′						
0 5	68754.94	.014	.018	.145	.001	.001
10	34377.48	.027	.036	.291	.001	.001
15	22918.33	.041	.055	.436	.002	.002
20	17188.76	.055	.073	.582	.002	.003
25	13751.02	.068	.091	.727	.003	.004
30	11459.19	.082	.109	.873	.004	.004
35	9822.18	.095	.127	1.018	.004	.005
40	8594.41	.109	.145	1.164	.005	.006
45	7639.49	.123	.164	1.309	.005	.007
50	6875.55	.136	.182	1.454	.006	.007
55	6250.51	.150	.200	1.600	.006	.008
1 0	5729.65	.164	.218	1.745	.007	.009
5	5288.92	.177	.236	1.891	.008	.009
10	4911.15	.191	.255	2.036	.008	.010
15	4583.75	.205	.273	2.182	.009	.011
20	4297.28	.218	.291	2.327	.009	.012
25	4044.51	.232	.309	2.472	.010	.012
30	3819.83	.245	.327	2.618	.011	.013
35	3618.80	.259	.345	2.763	.011	.014
40	3437.87	.273	.364	2.909	.012	.015
45	3274.17	.286	.382	3.054	.012	.015

Degree.	Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
		25.	50.		18.	20.
° ′						
1 50	3125.36	.300	.400	3.200	.013	.016
55	2989.48	.314	.418	3.345	.014	.017
2 0	2864.93	.327	.436	3.490	.014	.017
5	2750.35	.341	.455	3.636	.015	.018
10	2644.58	.355	.473	3.781	.015	.019
15	2546.64	.368	.491	3.927	.016	.020
20	2455.70	.382	.509	4.072	.016	.020
25	2371.04	.395	.527	4.218	.017	.021
30	2292.01	.409	.545	4.363	.018	.022
35	2218.09	.423	.564	4.508	.018	.023
40	2148.79	.436	.582	4.654	.019	.023
45	2083.68	.450	.600	4.799	.019	.024
50	2022.41	.464	.618	4.945	.020	.025
55	1964.64	.477	.636	5.090	.021	.025
3 0	1910.08	.491	.655	5.235	.021	.026
5	1858.47	.505	.673	5.381	.022	.027
10	1809.57	.518	.691	5.526	.022	.028
15	1763.18	.532	.709	5.672	.023	.028
20	1719.12	.545	.727	5.817	.024	.029
25	1677.20	.559	.745	5.962	.024	.030
30	1637.28	.573	.764	6.108	.025	.031
35	1599.21	.586	.782	6.253	.025	.031
40	1562.88	.600	.800	6.398	.026	.032
45	1528.16	.614	.818	6.544	.027	.033
50	1494.95	.627	.836	6.689	.027	.033
55	1463.16	.641	.855	6.835	.028	.034
4 0	1432.69	.655	.873	6.980	.028	.035
5	1402.46	.668	.891	7.125	.029	.036
10	1375.40	.682	.909	7.271	.029	.036
15	1348.45	.695	.927	7.416	.030	.037

Degree.	Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
		25.	50.		18.	20.
° ′						
4 20	1322.53	.709	.945	7.561	.031	.038
25	1297.58	.723	.964	7.707	.031	.039
30	1273.57	.736	.982	7.852	.032	.039
35	1250.42	.750	1.000	7.997	.032	.040
40	1228.11	.764	1.018	8.143	.033	.041
45	1206.57	.777	1.036	8.288	.034	.041
50	1185.78	.791	1.055	8.433	.034	.042
55	1165.70	.805	1.073	8.579	.035	.043
5 0	1146.28	.818	1.091	8.724	.035	.044
5	1127.50	.832	1.109	8.869	.036	.044
10	1109.33	.846	1.127	9.014	.037	.045
15	1091.73	.859	1.146	9.160	.037	.046
20	1074.68	.873	1.164	9.305	.038	.047
25	1058.16	.887	1.182	9.450	.038	.047
30	1042.14	.900	1.200	9.596	.039	.048
35	1026.60	.914	1.218	9.741	.039	.049
40	1011.51	.928	1.237	9.886	.040	.049
45	996.87	.941	1.255	10.031	.041	.050
50	982.64	.955	1.273	10.177	.041	.051
55	968.81	.968	1.291	10.322	.042	.052
6 0	955.37	.982	1.309	10.467	.042	.052
5	942.29	.996	1.327	10.612	.043	.053
10	929.57	1.009	1.346	10.758	.044	.054
15	917.19	1.023	1.364	10.903	.044	.055
20	905.13	1.037	1.382	11.048	.045	.055
25	893.39	1.050	1.400	11.193	.045	.056
30	881.95	1.064	1.418	11.339	.046	.057
35	870.79	1.078	1.437	11.484	.047	.057
40	859.92	1.091	1.455	11.629	.047	.058
45	849.32	1.105	1.473	11.774	.048	.059

Degree.	Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
		25.	50.		18.	20.
° ′						
6 50	838.97	1.118	1.491	11.919	.048	.060
55	828.88	1.132	1.510	12.065	.049	.060
7 0	819.02	1.146	1.528	12.210	.049	.061
5	809.40	1.159	1.546	12.355	.050	.062
10	800.00	1.173	1.564	12.500	.051	.063
15	790.81	1.187	1.582	12.645	.051	.063
20	781.84	1.200	1.600	12.790	.052	.064
25	773.07	1.214	1.619	12.936	.052	.065
30	764.49	1.228	1.637	13.081	.053	.065
35	756.10	1.242	1.655	13.226	.054	.066
40	747.89	1.255	1.673	13.371	.054	.067
45	739.86	1.269	1.691	13.516	.055	.068
50	732.01	1.283	1.710	13.661	.055	.068
55	724.31	1.296	1.728	13.806	.056	.069
8 0	716.78	1.310	1.746	13.951	.057	.070
5	709.40	1.324	1.764	14.096	.057	.070
10	702.18	1.337	1.782	14.241	.058	.071
15	695.09	1.351	1.801	14.387	.058	.072
20	688.16	1.365	1.819	14.532	.059	.073
25	681.35	1.378	1.837	14.677	.059	.073
30	674.69	1.392	1.855	14.822	.060	.074
35	668.15	1.406	1.873	14.967	.061	.075
40	661.74	1.419	1.892	15.112	.061	.076
45	655.45	1.433	1.910	15.257	.062	.076
50	649.27	1.447	1.928	15.402	.062	.077
55	643.22	1.460	1.946	15.547	.063	.078
9 0	637.27	1.474	1.965	15.692	.064	.078
5	631.44	1.488	1.983	15.837	.064	.079
10	625.71	1.501	2.001	15.982	.065	.080
15	620.09	1.515	2.019	16.127	.065	.081

Degree.		Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
			25.	50.		18.	20.
°	′						
9	20	614.56	1.529	2.037	16.272	.066	.081
	25	609.14	1.542	2.056	16.417	.066	.082
	30	603.80	1.556	2.074	16.562	.067	.083
	35	598.57	1.570	2.092	16.707	.068	.084
	40	593.42	1.583	2.110	16.852	.068	.084
	45	588.36	1.597	2.128	16.996	.069	.085
	50	583.38	1.611	2.147	17.141	.069	.086
	55	578.49	1.624	2.165	17.286	.070	.086
10	0	573.69	1.638	2.183	17.431	.071	.087
	10	564.31	1.665	2.219	17.721	.072	.089
	20	555.23	1.693	2.256	18.011	.073	.090
	30	546.44	1.720	2.292	18.300	.074	.092
	40	537.92	1.748	2.329	18.590	.075	.093
	50	529.67	1.775	2.365	18.880	.076	.094
11	0	521.67	1.802	2.402	19.169	.078	.096
	10	513.91	1.830	2.438	19.459	.079	.097
	20	506.38	1.857	2.475	19.748	.080	.099
	30	499.06	1.884	2.511	20.038	.081	.100
	40	491.96	1.912	2.547	20.327	.082	.102
	50	485.05	1.938	2.584	20.616	.084	.103
12	0	478.34	1.967	2.620	20.906	.085	.105
	10	471.81	1.994	2.657	21.195	.086	.106
	20	465.46	2.021	2.693	21.484	.087	.107
	30	459.28	2.049	2.730	21.773	.088	.109
	40	453.26	2.076	2.766	22.063	.089	.110
	50	447.40	2.104	2.803	22.352	.091	.112
13	0	441.68	2.131	2.839	22.641	.092	.113
	10	436.12	2.159	2.876	22.930	.093	.115
	20	430.69	2.186	2.912	23.219	.094	.116
	30	425.40	2.213	2.949	23.507	.095	.118

Degree.	Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
		25.	50.		18.	20.
° ′						
13 40	420.23	2.241	2.985	23.796	.096	.119
50	415.19	2.268	3.022	24.085	.098	.120
14 0	410.28	2.296	3.058	24.374	.099	.122
10	405.47	2.323	3.095	24.663	.100	.123
20	400.78	2.351	3.131	24.951	.101	.125
30	396.20	2.378	3.168	25.240	.102	.126
40	391.72	2.406	3.204	25.528	.103	.128
50	387.34	2.433	3.241	25.817	.105	.129
15 0	383.06	2.461	3.277	26.105	.106	.131
10	378.88	2.488	3.314	26.394	.107	.132
20	374.79	2.515	3.350	26.682	.108	.133
30	370.78	2.543	3.387	26.970	.109	.135
40	366.86	2.570	3.423	27.258	.110	.136
50	363.02	2.598	3.460	27.547	.112	.138
16 0	359.26	2.625	3.496	27.835	.113	.139
10	355.59	2.653	3.533	28.123	.114	.141
20	351.98	2.680	3.569	28.411	.115	.142
30	348.45	2.708	3.606	28.699	.116	.143
40	344.99	2.736	3.643	28.986	.117	.145
50	341.60	2.763	3.679	29.274	.119	.146
17 0	338.27	2.791	3.716	29.562	.120	.148
10	335.01	2.818	3.752	29.850	.121	.149
20	331.82	2.846	3.789	30.137	.122	.151
30	328.68	2.873	3.825	30.425	.123	.152
40	325.60	2.901	3.862	30.712	.124	.154
50	322.59	2.928	3.898	31.000	.126	.155
18 0	319.62	2.956	3.935	31.287	.127	.156
10	316.71	2.983	3.972	31.574	.128	.158
20	313.86	3.011	4.008	31.861	.129	.159
30	311.06	3.039	4.045	32.149	.130	.161

RAILWAY CURVES.

Degree.	Radii.	Ordinates.		Chord Deflection.	Ordinates for Rails.	
		25.	50.		18.	20.
° ′						
18 40	308.30	3.066	4.081	32.436	.131	.162
50	305.60	3.094	4.118	32.723	.133	.164
19 0	302.94	3.121	4.155	33.010	.134	.165
10	300.33	3.149	4.191	33.296	.135	.166
20	297.77	3.177	4.228	33.583	.136	.168
30	295.25	3.204	4.265	33.870	.137	.169
40	292.77	3.232	4.301	34.157	.138	.171
50	290.33	3.259	4.338	34.443	.140	.172
20 0	287.94	3.287	4.374	34.730	.141	.174

THICKNESS OF ARCHES—Brick.

Rad. of Arch.	Thickness at Crown.	Rad. of Arch.	Thickness at Crown.	Rad. of Arch.	Thickness at Crown.
Feet.	Inches.	Feet.	Inches.	Feet.	Inches.
2	6.7	11	16.0	20	21.5
3	8.3	12	16.6	22	22.6
4	9.6	13	17.3	24	23.5
5	10.8	14	18.0	25	24.0
6	11.8	15	18.7	30	26.3
7	12.7	16	19.2	35	28.4
8	13.6	17	19.8	40	30.4
9	14.4	18	20.4	45	32.2
10	15.1	19	20 9	50	34.0

For arches of granite or other hard stone the above thickness may be reduced by one-fourth.

DIMENSIONS AND RESISTANCES OF PURE COPPER WIRE.*

Am. Gauge. Brown & Sharpe Number.	Diameter Mils.	Feet per lb.	Resistance at 75° F.	
			Ohms per mile.	Feet per ohm.
0000	460.000	1.56	.25903	20383.
000	409.640	1.97	.32664	16165.
00	364.800	1.49	.41187	12820.
0	324.950	3.13	.51909	10409.
1	289.300	3.95	.65490	8062.3
2	257.630	4.99	.82582	6393.7
3	229.420	6.29	1.0414	5070.2
4	204.310	7.93	1.3131	4021.0
5	181.940	10.00	1.6558	3188.7
6	162.020	12.61	2.0881	2528.7
7	144.280	15.90	2.6331	2005.2
8	128.490	20.05	3.3201	1590.3
9	114.430	25.28	4.1860	1261.3
10	101.890	31.38	5.2800	1000.0
11	90.742	40.20	6.6568	793.18
12	80.808	50.69	8.3940	629.02
13	71.961	63.91	10.585	498.83
14	64.084	80.59	13.680	385.97

*Calculated on the basis of Dr. Matthiessen's standard, viz.: 1 mile of pure copper wire of 1-16 in. diameter equals 13.59 ohms at 15.5° C. or 59.9° Fahr.

DIMENSIONS AND RESISTANCES OF PURE COPPER WIRE.

Am. Gauge. Brown & Sharpe Number.	Diameter Mils.	Feet per lb.	Resistance at 75° F.	
			Ohms per mile.	Feet per ohm.
15	57.068	101.63	16.477	321.02
16	50.820	128.14	21.221	248.81
17	45.257	161.59	26.761	197.30
18	40.303	203.76	33.745	156.47
19	35.390	264.26	43.765	120.64
20	31.961	324.00	53.658	98.401
21	28.462	408.56	67.660	78.037
22	25.347	515.15	85.283	61.911
23	22.571	649.66	107.59	49.087
24	20.100	819.21	135.67	38.918
25	17.900	1032.96	171.07	30.864
26	15.940	1302.61	215.79	24.469
27	14.195	1642.55	272.02	19.410
28	12.641	2071.22	343.02	15.393
29	11.257	2611.82	432.53	12.207
30	10.025	3293.97	545.39	9.6812
31	8.928	4152.22	671.99	7.8573
32	7.950	5236.66	867.27	6.0880
33	7.080	6602.71	1093.4	4.8290
34	6.304	8328.30	1379.3	3.8281
35	5.614	10501.35	1738.9	3.0363
36	5.000	13238.83	2192.5	2.4082
37	4.453	16691.06	2765.5	1.9093
38	3.965	20854.65	3486.7	1.5143
39	3.531	26302.23	4395.5	1.2012
40	3.144	33175.94	5542.1	.9527

COPPER WIRE.

Weight and Length.

B.W.G., No.	Diameter. Inch.	Area. Circular Mils=d^2.	Pounds per mile, 1,760 yds.	Feet per pound.
0000	.454	206116	3294.32	1.60276
000	.425	180625	2886.89	1.82895
00	.380	144400	2307.92	2.28777
0	.34	115600	1847.62	3.85773
1	.300	90000	1438.43	3.6706
2	.284	80656	1289.11	4.0958
3	.259	67081	1072.15	4.9247
4	.238	56644	905.333	5.8321
5	.22	48400	773.56	6.8255
6	.203	41209	658.638	8.0165
7	.18	32400	517.844	10.1962
8	.165	27225	435.235	12.1345
9	.148	21904	350.089	15.0818
10	.134	17956	286.99	18.398
11	.12	14400	230.152	22.9413
12	.109	11881	189.893	27.805
13	.095	9025	144.245	36.6046
14	.083	6889	110.1061	47.954
15	.072	5184	82.855	63.7267
16	.065	4225	67.6276	78.1902
17	.058	3364	53.7665	98.203
18	.049	2401	38.3748	137.590
19	.042	1764	28.1837	187.276

COPPER WIRE.

Weight and Length—*continued.*

B.W.G., No.	Diameter. Inch.	Area. Circular Mils=d^2.	Pounds per mile, 1,760 yds.	Feet per pound.
20	.035	1225	19.579	269.676
21	.032	1024	16.3665	322.610
22	.028	784	12.5301	421.384
23	.025	625	9.9892	528.570
24	.022	484	7.7357	682.55
25	.020	400	6.39315	825.883
26	.018	324	5.17844	1019.61
27	.016	256	4.0916	1290.44
28	.014	196	3.13264	1685.48
29	.013	169	2.7011	1954.76
30	.012	144	2.30152	2294.18

Length and Resistance.

B.W.G., No.	Feet per ohm.	Miles per ohm.	Ohms per mile.
0000	19966.5	3.7815	.264443
000	17497.15	3.31385	.301763
00	13988.04	2.64925	.377465
0	11198.17	2.12086	.471505
1	8718.30	1.6512	.60562
2	7813.50	1.47973	.67580
3	6498.14	1.23071	.81254
4	5487.107	1.03923	.962256

COPPER WIRE.

LENGTH AND RESISTANCE—*continued.*

B.W.G., No.	Feet per ohm.	Miles per ohm.	Ohms per mile.
5	4688.51	.887975	1.12616
6	3991.91	.756044	1.32267
7	3138.59	.59443	1.68228
8	2637.29	.499486	2.00206
9	2121.84	.401864	2.488405
10	1739.40	.329432	3.03553
11	1394.93	.264191	3.78514
12	1150.91	.217976	4.58766
13	874.252	.165578	6.03945
14	667.338	.12639	7.91203
15	502.175	.095109	10.5142
16	409.276	.077514	12.9008
17	325.871	.061718	16.20274
18	232.585	.04405	22.7014
19	170.879	.032363	30.8991
20	149.3915	.022475	44.4947
21	99.195	.018787	53.2285
22	75.9461	.014384	69.5230
23	60.5437	.011467	87.2090
24	46.8851	.008 79	112.616
25	38.748	.007338	136.265
26	31.3859	.005944	168.229
27	24.7987	.004696	212.914
28	18.9865	.003595	278.092
29	16.3710	.003100	322.522
30	13.9493	.002641	378.514

MELTING POINT OF METALS AND ALLOYS.

Mercury	38°	Fah.
Tin	442°	"
Bismuth	497°	"
Lead	612°	"
Zinc	773°	"
Antimony	810°	"
Brass	1,869°	"
Silver	1,873°	"
German Silver	about 2,000°	"
Copper	1,996°	"
Gold	2,016°	"
Iron, Cast	2,786°	"
" Wrought	3,286°	"
Nickel (approximately)	2,800°	"
Manganese "	3,000°	"
Platinum	3,286°	"

FUSIBLE ALLOYS.

For Safety Plugs and Fire Alarms.

(FUSIBLE AMALGAM.)

Melting at 53° C.—Arcet's metal 9 parts.
Mercury 1 "

(WOOD'S ALLOY.)

" 66°–71°—Lead 2 parts.
Tin 4 "
Bismuth 7 to 8 "
Cadmium 1 to 2 "

(ARCET'S METAL.)

" 94° C.—Lead 5 parts.
Tin 3 "
Bismuth 8 "

" 210° F.—Tin 3, lead 5, bismuth about 8 parts.

" 246° F.—Tin 4, bismuth 5, lead 1 part.

" 286° F.—Tin 1, bismuth 1 part.

" 334° F.— { Tin 2, bismuth 1 part.
{ Tin 3, lead 2 parts.

ALLOYS USED IN ELECTRICAL WORK.

ALLOYS.	Tin.	Copper.	Zinc.	Antimony.	Lead.	Bismuth.
Brass, engine bearings...	13	112	¼	..	..	..
Tough brass, engine work.	15	100	15	..	..	..
" "	25	160	5	..	..	..
Yellow brass.....	..	2	1	..	..	..
Flanges to stand brazing..	..	32	1	..	1	..
Bell-metal.....	5	16	..	..	..	..
Babbitt's metal	10	1	..	1	..	..
Brass, for bearings.....	7	64	1	..	..	..
" for straps.....	16	130	1	..	..	..
Muntz's sheathing.....	..	6	4	..	..	..
Metal to expand in cooling.	..	..	..	2	9	1
Pewter.....	100	..	..	17	..	..
Spelter.....	..	1	1	..	..	..
Statuary bronze.....	2	90	5	..	2	..
Type-metal .....from	..	..	..	1	3	..
" .....to	..	..	..	1	7	..
SOLDERS.						
For lead.....	1	..	..	..	1½	..
" tin.....	1	..	..	..	2	..
" pewter.....	2	..	..	..	1	..
" brazing (hardest).....	..	3	1	..	..	..
" " (hard).....	..	1	1	..	..	..
" " (soft).....	1	4	3	..	..	..
" " " .....or	2	..	..	1	..	..

ALLOYS USED IN ELECTRICAL INSTRUMENT WORK.

	Tin.	Copper.	Zinc.	Nickel.	Scrap Brass.
"Free" Brass	..	2	1	..	..
Common Brass	..	1	1	..	1
"Deep Red Gun" Metal	1	9	..	..	..
"Best" Gun Metal	1	8	..	..	..
German Silver, Best	..	2	1	1	..
" " 2nd Quality	..	2	1	.5	..
Babbitt's Metal	10	1	..	..	..

Red and Best Gun Metals ought to have 1½ lbs. per cwt. of zinc added, and the alloy should be melted twice to insure *sound* castings. In making German silver, the nickel and copper are placed in layers in the crucible and the zinc added afterwards.

SOLDERING.

For electric apparatus resin should be used as flux. If chloride of zinc is used, it harbors damp, besides corroding the metals. Iron line wires are soldered together by chloride of zinc solution (zinc dissolved in spirit of salt), with a little HCl added to clean the surfaces. Rain cleans the joint. When copper wire is soldered to iron, zinc, etc., resin should be used, or if chloride of zinc, the joint should be washed afterwards to remove the acid. Unannealed wires should be soldered at as low a temperature as possible.

SOLDERS.

	Parts.
Soft spelter solder (for common brass-work)	1 copper, 1 zinc.
	1½ " 6 " or 10 brass
Hard spelter solder (for iron)	2 " 1 "
For fine brass-work	8 " 8 " 1 silver.
For steel	3 " 1 " 19 "
Hard silver solder	1 " – " 4 "
Soft " "	2 silver, 1 brass wire.
Gold solder	24 gold, 2 silver, 1 copper.

Silver solders are used for joining the individual wires in cables, and fine work in apparatus. They are very fusible and non-corrosive.

Coarse tin solder	tin, 1; lead 2 to 3.
Common tin solder	" 1; " 1
Fine tin solder	" 2; " 1

These are used for line wires, the last being best.

Pewterer's soft solder (for lead)	bismuth 2 parts, lead 4, tin 3.
Pewterer's common solder	bismuth 1 " " 1, tin 2.
Pewterer's com. solder, fusing at 320° Fah	bismuth 8 " " 4, tin 4.
Pewterer's com. solder, fusing at 202° Fah	bismuth 8 " 3, tin 5.

Mercury reduces the fusing point still further. These solders are useful for soldering tinfoil in making lead tubes and covered wires. The tenacity of fine tin solder is about 7,500 lbs. per square inch.

FLUXES FOR SOLDERING OR WELDING.

Iron or steel	Borax or sal-ammoniac.
Tinned iron	Resin or chloride of zinc.
Copper and brass	Sal-ammoniac or chloride of zinc.
Zinc	Chloride of zinc.
Lead	Tallow or resin.
Lead and tin pipes	Resin and sweet oil.

BRAZING.

The edges filed or scraped clean and bright, covered with spelter and powdered borax and exposed in a clear fire to a heat sufficient to melt the solder.

CASE-HARDENING.

Place horn, hoof, bone-dust, or shreds of leather, together with the article to be case-hardened, in an iron box subject to a blood-red heat, then immerse the article in cold water.

Some engineers cut up the shreds, etc., fine, and mix them with white wine vinegar and salt.

CASE-HARDENING WITH YELLOW PRUSSIATE OF POTASH.

Heat the articles after polishing to a bright red, rub the surface over with prussiate of potash; allow it to cool to dull red, and immerse it in water.

CASE-HARDENING MIXTURES.

3 prussiate of potash to 1 of sal-ammoniac mixed, or 2 sal-ammoniac, 2 of bone-dust, and 1 of prussiate of potash.

LACQUER FOR BRASS.

8 oz. shellac dissolved in 1 gallon spirits of wine; or 8 oz. shellac, 2 oz. gum sandarac, 2 oz. annato, ¼ oz. dragon's blood, dissolved in 1 gallon spirits of wine.

LACQUER FOR IRON.

3 lbs. asphalt, ½ lb. shellac, dissolved in 1 gallon of turpentine; or 12 of amber, 12 of turpentine, 2 of asphalt, and 6 oz. of drying oil.

CONTRACTION OF CASTINGS.

	Inch.	Inches of length.
In thin Brass castings		$\frac{5}{32}$ in 9
" thick " "		$\frac{3}{16}$ " 10
" Zinc castings		$\frac{3}{16}$ " 12
" Lead, according to purity	$\frac{3}{16}$ to	$\frac{5}{16}$ " 12
" Copper " "	$\frac{3}{16}$ "	$\frac{7}{32}$ " 12
" Tin " "	$\frac{7}{32}$ "	$\frac{1}{16}$ " 12
" Silver " "		$\frac{1}{8}$ " 12
" Cast Iron " " small castings		$\frac{1}{10}$ " 12
" " " " pipes		$\frac{1}{8}$ " 12
" Cast Steel.		

The above values fluctuate with the form of pattern, amount of ramming, and temperature of metal when poured. Green sand castings contract less than loam or dry sand castings.

PROPORTIONATE WEIGHT OF CASTING TO WEIGHT OF WOOD PATTERN.

A Pattern weighing One Pound made of	Cast Iron.	Brass.	Copper.	Bronze.	Bell Metal.	Zinc.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Pine or Fir will weigh in..	14	15.8	16.7	16.3	17.1	13.5
Oak " " ..	9	10.1	10.4	10.3	10.9	8.6
Beech " " ..	9.7	10.9	11.4	11.3	11.9	9.1
Linden " " ..	13.4	15.1	16.7	15.5	16.3	12.9
Pear " " ..	10.2	11.5	11.9	11.8	12.4	9.8
Birch " " ..	10.6	11.9	12.3	12.2	12.9	10.2
Alder " " ..	12.8	14.3	14.9	14.7	15.5	12.2
Mahogany " " ..	11.7	13.2	13.7	13.5	14.2	11.2
Brass " " ..	0.84	0.95	0.99	0.98	1.0	0.81

WEIGHT OF IRON BOLTS WITH HEXAGON NUTS.

Length.	½″	⅝″	¾″	⅞″	1″	1⅛″	1¼″
ins.	oz.	oz.	oz.	oz.	lbs.	lbs.	lbs.
1½	3½	7	12	17⅝	1⅛	2⅛	2⅝
2	4	7⅞	13	18¾	1¼	2¼	2¾
2½	4¼	8¼	14	20¼	1⅜	2⅜	3
3	4⅞	9	15	21½	1⅞	2⅝	3⅛
3½	4¾	9¾	16	23	2	2¾	3¼
4	5½	10¼	17	24⅛	2 1/16	2⅞	3½
4½	6	11	18	25⅝	2 3/16	3	3⅝
5	6⅝	11½	19	26¾	2¼	3⅛	3¾
5½	7	12¼	20	28¼	2⅜	3⅜	4
6	7¼	13	21	29⅝	2½	3⅝	4¼
6½	7½	13¾	22	30¾	2⅝	3¾	4⅜
7	8	14¼	23	32⅛	2⅞	3⅞	4½
7½	8⅜	15	24	33¾	2 13/16	3⅞	4⅝
8	8¾	15½	25	35¼	3	4	4¾
8½	9¼	16	26	36½	3 1/16	4⅛	5
9	9¾	16¾	27	37½	3⅛	4¼	5⅛
9½	10¼	17⅜	28	39	3¼	4⅜	5¼
10	10⅝	18¼	29	40⅛	3⅜	4½	5⅜
10½	11	18¾	30	41⅛	3½	4⅝	5½
11	11¼	19⅜	31	43	3⅝	4¾	5⅝
11½	11¾	20¼	32	44½	3⅝	5	6
12	12¼	21	33	45⅝	3¾	5⅛	6⅛

SHRINKAGE OF CASTINGS.

	inch.	
Cast iron	1/8	per lineal foot.
Brass	1/16	
Lead	1/16	
Tin	1/4	
Zinc	5/16	

CRUSHING STRENGTH OF WROUGHT IRON COLUMNS WITH FLAT END BEARINGS.

Pressures in lbs. per square inch.

Length of Column in Terms of Least Diameter.	Square Column.	Phœnix Column.
10	37.740	41.609
11	37.733	41.404
12	37.581	41.189
13	37.421	40.961
14	37.249	40.721
15	37.067	40.476
16	36.876	40.212
17	36.679	39.935
18	36.470	39.645
19	36.252	39.343
20	36.024	39.030
21	35.785	38.706
22	35.544	38.373
23	35.292	38.029
24	35.033	37.677
25	34.767	37.317
26	34.492	36.949
27	34.212	36.575
28	33.929	36.192
29	33.639	35.807
30	33.344	35.424
31	33.044	35.021
32	32.740	34.621
33	32.431	34.219
34	32.120	33.813
35	31.806	33.406
40	30.198	31.352

ULTIMATE STRENGTH OF COLUMNS WITH ONE PIN END.

Length of Column in Terms of Least Diameter.	Square Column.	Phœnix Column.
10	37.506	38.567
11	37.188	38.145
12	36.860	37.713
13	36.524	37.270
14	36.178	36.817
15	35.824	36.364
16	35.494	35.940
17	35.121	35.458
18	34.748	34.957
19	34.368	34.470
20	33.971	33.962
21	33.566	33.445
22	33.152	32.919
23	32.729	32.386
24	32.299	31.847
25	31.862	31.304
26	31.420	30.759
27	30.973	30.212
28	30.523	29.664
29	30.070	29.117
30	29.615	28.571
31	29.153	28.029
32	28.703	27.489
33	28.246	26.948
34	27.794	26.424
35	27.337	25.899
36	26.885	25.381
37	26.424	24.869
38	25.990	24.364
39	25.547	23.866
40	25.109	23.377

ULTIMATE STRENGTH OF COLUMNS WITH TWO PIN ENDS.

Length of Column in Terms of Least Diameter.	Square Column.	Phœnix Column.
10	36.128	34.515
11	35.690	33.914
12	35.240	33.440
13	34.780	32.922
14	34.307	32.374
15	33.800	31.825
16	33.319	31.240
17	33.814	30.669
18	32.296	30.084
19	31.766	29.494
20	31.226	28.894
21	30.679	28.283
22	30.126	27.670
23	29.568	27.057
24	29.007	26.444
25	28.444	25.834
26	27.880	25.229
27	27.318	24.629
28	26.759	24.036
29	26.202	23.451
30	25.650	22.874
31	25.103	22.307
32	24.561	21.750
33	24.028	21.204
34	23.501	20.669
35	22.982	20.146
36	22.472	19.635
37	21.970	19.135
38	21.477	18.647
39	20.994	18.172
40	20.520	17.709

TABLE SHOWING THE AREA, AVERAGE DEPTH, AND ELEVATION OF THE PRINCIPAL LAKES ON THE GLOBE.

Names of Lakes.	Area in Square Miles.	Average Depth in feet.	Elevation of surface above level of the sea in feet.
Caspian Sea	145,000	250	—83.4
Sea of Aral.....	30,000	100	—26
Dead Sea.....	300	200	—1,312
Lake Baikal.....	14,000	..	1,280
Lake Superior....	31,500	1,000	600
Lake Michigan...	23,150	1,000	578
Lake Huron.....	23,100	1,000	578
Lake Erie.....	7,800	204	565
Lake Ontario....	6,900	636	231
Lake Nicaragua..	4,000	300	300
Lake Titicaca....	4,000	700	12,846
Great Salt Lake..	1,875	..	4,210
Lake Tchad.....	14,000	..	830
Lake Ladoga.....	6,190	1,200	..

ANNUAL RAINFALL IN THE UNITED STATES.

On the Atlantic Seaboard.

	Inches.
Boston (lat. 42°21′).....	44
New York (lat. 40°43′).....	45
Philadelphia (lat. 40°).....	43½
Washington (lat. 38°53′).....	40
Charleston (lat. 32°46′).....	48
St. Augustine (lat. 29°48′).....	32

ON THE GULF.

	Inches.
Mobile (lat. 30°42′)	64
New Orleans (lat. 29°57′)	51

IN THE MISSISSIPPI VALLEY.

St. Louis (lat. 38°37′)	42
Cincinnati (lat. 39°6′)	47

ON THE PACIFIC COAST.

Portland, Oregon (lat. 46°11′)	39
Port Oxford (lat. 42°44′)	71
San Francisco (lat. 37°48′)	23

DISTANCES AND AREAS ON THE SURFACE OF THE GLOBE.

At ° Lat.	Longitude.		Latitude.	
	Feet to 1′.	Miles to 1°.	Feet to 1′.	Miles to 1°.
0	6086	69.15	6045	68.69
10	5994	68.11	6047	68.70
20	5721	65.01	6053	68.77
30	5275	59.94	6061	68.88
40	4669	53.05	6071	69.00
45	4311	48.99	6076	69.05
50	3920	44.54	6081	69.10
60	3051	34.66	6091	69.21
70	2088	23.73	6100	69.32
80	1060	12.05	6105	69.38
90	0	0	6107	69.39

TABLE OF VOLUMES OF AIR OR OTHER GASEOUS BODY AT DIFFERENT PRESSURES AND TEMPERATURES.—The Volume at 60° F. and 30 inches Barometric Pressure being taken as a Standard Unit.

Bar.	Temperature.					
In.	48°	50°	52°	54°	56°	58°
28.0	.960	.956	.951	.946	.942	.937
28.1	.964	.959	.955	.951	.945	.941
28.2	.967	.963	.958	.953	.949	.944
28.3	.971	.966	.961	.957	.952	.947
28.4	.974	.970	.965	.960	.955	.951
28.5	.978	.973	.968	.964	.959	.954
28.6	.981	.977	.972	.967	.962	.958
28.7	.985	.980	.975	.970	.966	.961
28.8	.988	.984	.979	.974	.969	.964
28.9	.992	.987	.982	.977	.973	.968
29.0	.995	.990	.986	.981	.976	.971
29.1	.999	.994	.989	.984	.979	.975
29.2	1.002	.997	.992	.988	.982	.978
29.3	1.006	1.001	.996	.991	.986	.981
29.4	1.009	1.004	.999	.995	.990	.985
29.5	1.013	1.008	1.003	.998	.993	.988
29.6	1.016	1.011	1.006	1.001	.996	.992
29.7	1.019	1.015	1.010	1.005	1.000	.995
29.8	1.023	1.018	1.013	1.008	1.003	.998
29.9	1.026	1.022	1.017	1.012	1.007	1.002
30.0	1.030	1.025	1.020	1.015	1.010	1.005
30.1	1.033	1.029	1.024	1.019	1.014	1.009
30.2	1.037	1.032	1.027	1.022	1.017	1.012
30.3	1.040	1.036	1.030	1.025	1.020	1.015
30.4	1.044	1.039	1.034	1.029	1.024	1.019
30.5	1.047	1.042	1.037	1.032	1.027	1.022
30.6	1.051	1.046	1.041	1.036	1.031	1.026
30.7	1.054	1.049	1.044	1.039	1.034	1.029
30.8	1.058	1.053	1.048	1.043	1.037	1.032
30.9	1.061	1.056	1.051	1.046	1.041	1.036
31.0	1.065	1.060	1.055	1.049	1.044	1.039

TABLE OF VOLUMES OF AIR OR OTHER GASEOUS BODY AT DIFFERENT PRESSURES AND TEMPERATURES—*continued.*

Bar. In.	Temperature.				
	60°	62°	64°	66°	68°
28.0	.932	.927	.922	.917	.912
28.1	.936	.930	.926	.921	.916
28.2	.939	.934	.929	.924	.919
28.3	.942	.937	.932	.928	.922
28.4	.946	.941	.936	.931	.926
28.5	.949	.944	.939	.934	.929
28.6	.953	.947	.943	.938	.932
28.7	.956	.951	.946	.941	.936
28.8	.959	.954	.949	.944	.939
28.9	.963	.958	.953	.948	.942
29.0	.966	.961	.956	.951	.946
29.1	.969	.964	.959	.954	.949
29.2	.973	.968	.963	.958	.952
29.3	.976	.971	.966	.961	.956
29.4	.980	.975	.969	.964	.959
29.5	.983	.978	.973	.968	.962
29.6	.986	.981	.976	.971	.966
29.7	.990	.985	.980	.974	.969
29.8	.993	.988	.983	.978	.972
29.9	.997	.991	.986	.981	.976
30.0	1.000	.995	.990	.985	.979
30.1	1.003	.998	.993	.988	.983
30.2	1.007	1.002	.996	.991	.986
30.3	1.010	1.005	1.000	.995	.989
30.4	1.014	1.008	1.003	.998	.993
30.5	1.017	1.012	1.006	1.001	.996
30.6	1.020	1.015	1.010	1.005	.999
30.7	1.024	1.018	1.013	1.008	1.003
30.8	1.027	1.022	1.017	1.011	1.006
30.9	1.031	1.025	1.020	1.015	1.009
31.0	1.034	1.029	1.023	1.018	1.013

TABLE OF VOLUMES OF AIR OR OTHER GASEOUS BODY AT DIFFERENT PRESSURES AND TEMPERATURES—*continued.*

Bar.	Temperature.				
In.	70°	72°	74°	76°	78°
28.0	.907	.902	.897	.892	.887
28.1	.911	.905	.900	.895	.890
28.2	.914	.909	.904	.898	.893
28.3	.917	.912	.907	.902	.896
28.4	.921	.915	.910	.905	.900
28.5	.924	.919	.914	.908	.903
28.6	.927	.922	.917	.912	.906
28.7	.931	.925	.920	.915	.909
28.8	.934	.929	.924	.918	.913
28.9	.937	.932	.927	.921	.916
29.0	.941	.935	.930	.925	.919
29.1	.944	.939	.933	.928	.923
29.2	.947	.942	.937	.931	.926
29.3	.950	.945	.940	.935	.929
29.4	.954	.949	.943	.938	.932
29.5	.957	.952	.947	.941	.936
29.6	.960	.955	.950	.944	.939
29.7	.964	.959	.953	.948	.942
29.8	.967	.962	.957	.951	.946
29.9	.970	.965	.960	.954	.949
30.0	.974	.968	.963	.958	.952
30.1	.977	.972	.966	.961	.955
30.2	.980	.975	.970	.964	.959
30.3	.984	.978	.973	.968	.962
30.4	.987	.982	.976	.971	.965
30.5	.990	.985	.980	.974	.969
30.6	.994	.988	.983	.977	.972
30.7	.997	.992	.986	.981	.975
30.8	1.000	.995	.990	.984	.978
30.9	1.004	.998	.993	.987	.982
31.0	1.007	1.002	.996	.991	.985

OF THE VOLUME AND WEIGHT OF DRY AIR

AT DIFFERENT TEMPERATURES UNDER A CONSTANT ATMOSPHERIC PRESSURE OF 29.92 INCHES OF MERCURY, THE VOLUME AT 32° FAHRENHEIT BEING 1.

Temp. in Deg.	Volume in cubic feet.	Weight of cub. ft. in lbs.	Temp. in Deg.	Volume in cubic feet.	Weight of cub. ft. in lbs.
32	1.000	0.0807	650	2.260	0.0357
42	1.020	0.0791	700	2.362	0.0338
52	1.041	0.0776	750	2.464	0.0328
62	1.061	0.0761	800	2.566	0.0315
72	1.082	0.0747	850	2.668	0.0303
82	1.102	0.0733	900	2.770	0.0292
92	1.122	0.0720	950	2.872	0.0281
102	1.143	0.0707	1,000	2.974	0.0268
112	1.163	0.0694	1,100	3.177	0.0254
122	1.184	0.0682	1,200	3.381	0.0239
132	1.204	0.0671	1,300	3.585	0.0225
142	1.224	0.0660	1,400	3.789	0.0213
152	1.245	0.0649	1,500	3.993	0.0202
162	1.265	0.0638	1,600	4.197	0.0192
172	1.285	0.0628	1,700	4.401	0.0183
182	1.306	0.0618	1,800	4.605	0.0175
192	1.326	0.0609	1,900	4.809	0.0168
202	1.347	0.0600	2,000	5.012	0.0161
212	1.367	0.0591	2,100	5.216	0.0155
230	1.404	0.0575	2,200	5.420	0.0149
250	1.444	0.0559	2,300	5.624	0.0142
275	1.495	0.0540	2,400	5.828	0.0138
300	1.546	0.0522	2,500	6.032	0.0133
325	1.597	0.0506	2,600	6.236	0.0130
350	1.648	0.0490	2,700	6.440	0.0125
375	1.689	0.0477	2,800	6.644	0.0121
400	1.750	0.0461	2,900	6.847	0.0118
450	1.852	0.0436	3,000	7.051	0.0114
500	1.954	0.0413	3,100	7.255	0.0111
550	2.056	0.0384	3,200	7.459	0.0108
600	2.158	0.0376			

HEAT PRODUCED BY COMPRESSION OF AIR.

Atmospheres.	Pressure.		Volume in Cubic Feet.	Temperature of the Air throughout the Process. Degrees.	Total Increase of Temperature. Degrees.
	Pounds per Square Inch above a Vacuum.	Pounds per Square Inch above the Atmosphere.			
1.00	14.70	0.00	1.0000	60.0	00.0
1.10	16.17	1.47	0.9346	74.6	14.6
1.25	18.37	3.67	0.8536	94.8	34.8
1.50	22.05	7.35	0.7501	124.9	64.9
1.75	25.81	11.11	0.6724	151.6	91.6
2.00	29.40	14.70	0.6117	175.8	115.8
2.50	36.70	22.00	0.5221	218.3	158.3
3.00	44.10	29.40	0.4588	255.1	195.1
3.50	51.40	36.70	0.4113	287.8	227.8
4.00	58.80	44.10	0.3741	317.4	257.4
5.00	73.50	58.80	0.3194	369.4	309.4
6.00	88.20	73.50	0.2806	414.5	354.5
7.00	102.90	88.20	0.2516	454.5	394.5
8.00	117.60	102.90	0.2288	490.6	430.6
9.00	132.30	117.60	0.2105	523.7	463.4
10.00	147.00	132.30	0.1953	554.0	494.0
15.00	220.50	205.80	0.1465	681.0	621.0
20.00	294.00	279.30	0.1195	781.0	721.0
25.00	367.50	352.80	0.1020	864.0	804.0

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